Answers to Clemson University Biology Merit Exam
27 April 2018

1. d) Correct. The specific epithet should not be capitalized.

2. a) No, if it were genus and species, the two words would be Alligator and “Alligator mississippiensis” or “A. mississippiensis.” “Mississippiensis” means nothing by itself. There could be several unrelated species with the epithet “mississippiensis.”
   b) Correct. The genus should always be followed by the specific epithet unless we were talking about the whole genus (e.g., “the genus Homo.”

3. c) No. In fact, alligators and crocodiles evolved from a common ancestor that was a crocodilian but not yet a crocodile.
   d) Correct. The taxa with the most species are not necessarily the oldest or the youngest.

4. a) Correct. Yes, their teeth. When they close their mouths, alligators don’t show any bottom teeth but crocodiles do.

5. a) No, Vertebrata is their subphylum.
   b) Correct. Alligators are a member of all these groups, but their phylum is Chordata.
   c) No, Animalia is their kingdom.
   d) No, Reptilia is their class.

6. a) No. Crocodilians are not in the order Squamata (lizards and snakes).
   c) Correct. Birds are now regarded as a kind of crocodilian, believe it or not.

7. d) Correct. This is the reason we declare animals to be closely related. They have diverged from each other relatively recently in evolutionary time. Similarity doesn’t matter, but often animals that have diverged recently are pretty similar.

8. a) Correct. This was the Age of Mammals. The dinosaurs had died out and flowering plants dominated the earth, but reptiles were not standing still either.

9. b) Correct. 5.94 m x 39.4 inches/m = 234 inches = 19.5 feet.

10. a) No. Insects and crustaceans are arthropods.
    b) No. Plenty of worms are annelids.
    c) No. Snails are mollusks.
    d) Correct. Alligators would have to go a long way to get starfish or sea urchins.

11. a) Correct. Bony fish make up most of the diet. They would rarely run across a cartilaginous fish, a hagfish, or, especially, a trilobite.

12. c) Correct. Alligators can’t chew their food. Their teeth are solely for catching and holding prey. They have stones in their stomachs to help grind up the meat. For large prey, they store the carcass under water until it starts to decay, and then tear it apart by rotating their bodies.


14. d) Correct. Aerobic respiration oxidizes glucose to CO₂ and H₂O, but fermentation changes it to lactic acid (in animals).

15. b) Correct. A low pH because of the lactate being produced and also because of high concentrations of carbon dioxide. The other answers aren’t plausible.

16. c) Correct. Oxygen takes the hydrogens off of glucose and puts them on oxygen gas to form water. They are much more stable with water, and so they release most of their energy when they pass to water.
17. a) No, oxygen is oxidized. Reduced would mean it has a lot of hydrogen on it.
   b) No, its electrons are very stable because it is so electronegative.
   c) No, oxygen gas doesn’t have a large dipole moment because both oxygen atoms have the same electronegativity.
   d) Correct. This is why oxygen is such a great electron acceptor. It takes electrons from other molecules, holds them tightly, and allows them to release most of their energy.

18. a) No, the partial pressure of carbon dioxide would be lower. See the explanation below.
   b) Correct. The partial pressure of oxygen in our alveolar lungs is well below that of the environment because any air that comes in is mixed with stale air that can never be completely expelled. The alveolar air is also much higher in carbon dioxide than the atmosphere. But if the alligator maintains one-way flow of air, the air in the lungs has the same partial pressure of oxygen and carbon dioxide as the air outside. The correct answer cannot imply that the blood leaving the lungs has either lower oxygen or higher carbon dioxide than the human would have.

19. a) Correct. Their circulatory system cannot get oxygen to the muscles fast enough to keep them aerobic, so they go into fermentation and quickly build up a large oxygen debt. Then the debt cannot be satisfied quickly because circulation is slow and cannot deliver much oxygen.

20. c) Correct. The blood goes to the right side of the heart, then to the left side and out the aorta. This list leaves out the lungs.

21. b) Correct. In humans, the right side of the heart has a pressure only 1/5 of the left side. Any structures on the right side will have lower pressure. The peak pressure will be in the left ventricle.

22. a) No, sending blood around the body will not purge CO₂. The only way to do that is in the lungs.
   b) No, the muscles are probably the area with the lowest partial pressure of oxygen.
   c) No, we don’t want to take oxygen from the tissues. It’s the tissues that need oxygen.
   d) Correct. The idea here is that the lungs have been totally depleted of oxygen, so there is no point in sending blood there. However, hemoglobin has a large reserve of oxygen. In humans, only about 25% of the oxygen in hemoglobin is delivered in one pass through the systemic circulation. Sending the blood around and around the systemic circulation makes some sense.

23. a) No. The sarcoplasmic reticulum releases calcium, and titin does not coil around myosin.
   b) No. The first part might be right, but the second part is wrong.
   c) No. The binding of tropomyosin to actin prevents contraction.
   d) Correct. The binding of myosin to active sites on actin is what allows a muscle to be hold up a weight.

24. b) Correct. You can tell it’s ribose because it has an OH on its C2 carbon. Even if the student can’t identify adenine, he or she should know ribose.

25. a) Correct. Ribose is present in RNA only.

26. c) Correct. ATP is necessary to release myosin from actin. This is why dead bodies grow stiff. Their muscles all have myosin bound to actin, but without ATP, the connection cannot be broken. This is rigor mortis.

27. a) No. This will keep the muscles going, not make them tired.
   b) Correct. The high-energy molecules are gone and the muscles are full of reduced pyruvate that cannot be oxidized until oxygen returns. This is fatigue.
   d) No. If NADH were oxidized, contraction could continue. The problem in a fatigued muscle is that all the NAD⁺ is NADH. Glycolysis and the Krebs cycle need NAD⁺, not NADH.

28. d) Correct. The organ of Corti is where sounds are transduced into action potentials. The other parts of the ear may help us hear, but the transduction is in the organ of Corti.
29. a) Correct. Different pitches of sound activate different areas of the organ of Corti. And the intensity of the action potentials is always transmitted by the frequency of the action potentials because all action potentials are the same size.

30. d) Correct. Obviously, monopolizing all the mating benefits the dominant male. But it also helps the females because their offspring are sired by the most successful male in the area.

31. a) Correct. 34°F = [(9/5)*34] + 32 = 93.2°F.

32. b) Correct. Neurulas are gastrulas that have begun to make the dorsal hollow nerve tube.

33. c) Correct. It's a survivorship curve. The number of cohort members that remain are clearly on a log scale.

34. a) Correct. Before the hunt, there is so much mortality of young that the survivorship curve will definitely be Type III. We don't know if it will go completely to a Type II, but as survival of the young increases, it will trend in that direction.

35. b) Correct. With more young surviving, the base of the age structure will spread out. This is the only answer that allows that.

36. d) Correct. Given the information in the question, the only way two phenotypically normal parents could produce an albino offspring is if the cross was Pp x Pp, where p is the albino allele and P is the normal allele. PP x pp would have an albino parent, and PP x PP would not produce an albino offspring.

37. a) No. CRISPR-Cas9 cuts DNA at a spot directed by the guide RNA. It does not amplify DNA.
   b) No. The Sanger method sequences DNA.
   c) Correct. The whole purpose of polymerase chain reaction is making many copies of a certain segment of DNA.
   d) No. A Western blot is like a Southern blot, but applied to proteins. It does not amplify DNA either.

38. a) Correct. The enzyme cannot cut the normal allele but can cut the albino allele. Therefore, an albino offspring will produce two fragments and a heterozygote parent will produce three (one large one for the uncut normal allele and two smaller ones for the albino allele).

39. d) Correct. Some offspring will be PP (one band) and some will be Pp (three bands). None will have two bands because if they did, they would be pp and albino, and these are the non-albino offspring.

40. d) Correct. Our steps were to amplify the DNA, do a Southern blot that only showed some of the many bands that might be generated, and then visualize these bands on a gel. But for each of these steps, we had to know what specific DNA we were trying to see. If we didn't have primers to amplify it, a radioactive probe that would bind to it, and gel concentration and running time that was appropriate for it, we would never see it.