2011 TERM ESSAY

Environmental Physiology of Animals (Biol 322)

Assigned on: **March 2, 2011**
Due: **March 31, 2011 before 5pm "sharp" handing in a hardcopy to Rm. 3510, BioSci.** We need a soft copy of your essay for documentation. So you must also submit your essay through our Biol 322 WebCT site.

Extensions will only be granted under extenuating circumstances with written permission from the course instructor prior to the due date. Otherwise late submission will be subjected to 5% deduction per day.

The term paper can be up to 12 pages; double-spaced (less than 27 lines/page), minimum font size is 12 pt. Typed with 0.75-inch margin (not hand written). The 12- page limit does not include references, figures and/or tables if you wish to include them. Up to 8 individual figures and tables may be included to complement your written work. The figures will help you with your illustration (hint!).

This essay should incorporate as many aspects of physiological/ biochemical/morphological and even behavioral (but not to over do it) adaptations as you think are necessary to survive and thrive in the set of conditions outlined below. You must integrate **and fully explain** the physical, chemical, and physiological reasons for your choices, especially the functional underpinnings of your morphological designs and behavioral adjustments. A variety of the physiological systems we have studied and will study in the next few weeks (from movies, research seminars and guest lectures) must be incorporated in order to get excellent marks. This will include detailing the underlying principles for the choices that you make and how they are expected to help the animal physiologically. Be aware that adaptations may be beneficial at one site but not at another. Illustrations may be used to demonstrate understanding of the topic. Be concise with your description of the environmental setting and state the environmental challenges using scientific language. Students are encouraged to seek help and guidance from the T.A. and instructor. We will be available for discussion of principles. Please make an appointment via email, along with a brief description of your question. An excellent way to demonstrate your idea in this type of essay is to use diagrams and/or hypothetical "data" as to what environmental conditions would be expected at each site. You must reference your diagrams within the text of the essay. Starting **early** is the key to success in writing a thorough paper. You are encouraged to get together in groups to discuss the responses and/or adaptations required. This will really help you to understand the principles. However, your paper should be written **independently**.

You will be assigned marks for creativity to in your design. However, creativity will only give you a good mark if it is backed by sound physiological principles. This animal can be “fictional” and you are free to make up your own solutions to any physiological challenge that arises at each site. Any physiological/biochemical features that you wish to discuss outside the course material should be referenced appropriately (i.e., following proper citation format in scientific publications). You are required to have at least 10 references. You do not need to reference ideas derived directly from the lecture material. The focus of this paper should be on physical, physiological, structural and biochemical principles as we discussed in class. Although behavioral mechanisms are **acceptable** as well, they should only represent a minor component of your discussion. THE ANIMAL BEST SUITED TO FINISH THE COURSE WITH THE BEST POTENTIAL TO SURVIVE THE HARSH ENVIRONMENT, TO REPRODUCE AND TO GROW WILL SCORE EXTRA POINTS. You have one year to finish the journey.

Marking Scheme (100%):

Content (60%):
- -Identifying Environmental Challenges
- - Addressing physiological adjustments toward the environmental challenges
- - Logic and feasibility
- - Integration of various physiological systems

Writing (20%)
- Grammar and conciseness
- Clarity (e.g. figure illustration and tables legends)

References (10%):

Creativity and Innovation (10%)

Animal Trekking on the Dragon's Back in the New World

Preamble

"With glaciers marking its tip, active volcanoes running along its spine, snow-capped peaks rising high above its range, both wet and dry tropical rainforests within its interior, and desert, lowland savanna and alpine tundra in between, the Andes is an extraordinary world of diverse terrain, extreme temperatures and multifarious wildlife. Rising out of the Pacific Coast, this high mountain range is 5,000 miles long, extending over seven countries between Tierra del Fuego in the extreme south to the Caribbean coast in the north.

Once the realm of the ancient Incan Empire, this place of myth and legend also has a rich, intriguing natural history going back to the Jurassic period, marked by an event of monumental portion—the formation of the Central American land bridge 3 million years ago. The creatures of the Andes set this land apart from all other places on earth. The Andes are home to the zorro, a "false fox" with adaptations that make it a successful inhabitant of the Andes. The flamingo, too, has developed utterly unique and specialized adaptations in order to thrive in an environment that doesn't even seem livable—a salt pan.

Only a mountain range of extremes could harbor such a rich and diverse variety of life forms. Here you will find some of the highest, saltiest, wettest and driest terrains on the planet. Penguins, opossums, hummingbirds, llamas, pumas, foxes, condors, spectacled bears and many more have all managed to carve out an existence somewhere in one of the many worlds that we call the Andes" – Dragon's Back, Nature, PBS.

"Confining our view to South America, we should certainly be tempted to believe that trees flourished only under a very humid climate; for the limit of the forest-land follows, in a most remarkable manner, that of the damp winds. In the southern part of the continent, where the western gales, charged with moisture from the Pacific, prevail, every island on the broken west coast, from lat. 38° to the extreme point of Tierra del Fuego, is densely covered by impenetrable forests. On the eastern side of the Cordillera, over the same extent of latitude, where a blue sky and a fine climate prove that the atmosphere has been deprived of its moisture by passing over the mountains, the arid plains of Patagonia support a most scanty vegetation. " - Charles Darwin, The Voyage of the Beagle

You are going to design (prepare) an "animal" to embark on an imaginary "Journey" and survive through the terrain of the course provided. The animal will need to survive the journey and optimize multiple physiological systems to allow it to finish the journey with minimal chance of elimination. The most important element of the assignment is to complete the course. Your animal may fly. The course will include 5 sites comprising specific sets of environmental challenges. However you will need to identify the environmental challenges. Your "animal" is allowed up to 30 days at each stop to "reshape" and "rejuvenate". You will have to make sure the adjustment your animal made at the pit stop is biologically feasible. Therefore the adjustment you are making is more of acclimation than adaptation. You can make the adjustment in multiple systems (e.g. respiratory, circulatory, digestive….etc) during the pit-stop. You will determine the most important limiting factors your animal has to overcome during the next stage of its journey. You will need to keep in mind that any specific traits that are advantageous in the earlier leg may become a liability in the subsequent leg of trip if they were not modified. Therefore, you must implement appropriate compromises in your design with "multi-dimensional" foresight to provide your animal an overall advantage.

The journey starts in December at Lake Titicaca. Your animal needs to be ready to enter and finish a journey through the infamous "Dragon's back" – the world's longest mountain range along the border between Chile and Argentina – Andes. The journey will end at the glacier near Patagonia where the Andes dips into the Ocean (See map attached). You must also consider the seasonal, latitudinal and altitudinal climate changes as time proceeds in your journey. It is your decision to determine during which season the animal needs to be at a particular site and how long your animal will spend at that site. You will need to identify the seasonal- and regional-specific environmental characteristics for each site.

The theme of the journey is to focus on food (metabolic fuel) the animal can carry with (packing in the body, no knapsack please) and obtain (forage) along the way. You will need to identify at least three major environmental elements in each segment. The type of food you choose must be suitable to the environment. The elements you need to consider are, for example, temperature,

oxygen, water, osmolarity, acid-base, light, etc. The size of the animal is also an important consideration and traveling speed has to be realistic.

Your animal needs to endure and thrive in the environment while facing predation and foraging challenges. Since each segment varies in length your animal will have to decide if it will “refuel” in order to remain active, or undergo metabolic depression periodically in order to survive. You will need to determine the quality and quantity of food available to your animal at each site based on that site’s specific environmental habitat.

Good luck and enjoy your writing and research!

#1 Lake Titicaca
16º00’ S
69º00’ W

#2 Atacama Desert
24º30’ S
69º00’ W

Puerto Quellon

#3 Altiplano Salt Pan
19º00’ S
67º00’ W

#4 Aconcagua
6960m elev
32º30’ S
70º00’ W

#5 Torres Del Plains
51º00’ S
73º00’ W

0 500 Miles
0 500 KM
Parallel scale at 20°S 0°E

80°W 70°W 60°W 50°W 40°W