**Active Learning Exercise 20.1**

to accompany

*Vertebrate Life*, Tenth Edition

Pough • Janis

**Design a Vertebrate**

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**Activity**

It is important in vertebrate zoology, as in any science, to be able to ask good questions and speculate about reasonable answers: this is the basis of scientific inquiry. In this class you will work with your team on a creative project that will help you apply your growing knowledge of animal function throughout the term and that will push you to consider zoology not just as a collection of facts, but as a study of relationships.

Each group will be assigned some basic constraints. (*These are posted below-they choose at random.)* Within those limits, your group will create an animal. This is NOT to be a real animal that you have read about, although you should read all you want to about animals that exist in similar environments. It is to be a figment of your imagination. Throughout the term you will be given a series of assignments that ask you to add more and more features to your animal while working within environmental limits. You will need to integrate the new features with those you have already created. You will be given the grading rubric to follow. (*This is posted below.)* By the end of the term, you will have described an entire imaginary organism in detail, applying the ideas you have learned in class and through your reading during the semester. At the end of the semester, you will present a portion of your animal to the rest of the class, who will critique your solutions to the problems faced by your animal.

**Assignment #1**

Your first assignment is to clearly establish the environmental constraints for your animal. You will be given a brief description of your organism. You need to work with the members of your lab group to research the assigned environment. Consider availability of water, average temperature and temperature fluctuation both daily and throughout the seasons, food availability, shelter availability, likely predators, etc.

Write a description of the environment in which your animal lives. Include speculations about problems your animal may face in meeting its survival needs. Give your animal a name. No additional information about your animal is needed for this assignment.

Select the best artist in your group. Have that person begin to make some rough drawings of your mental image of your animal. This may change throughout the term, but it is a good idea to have some sort of shared image in your minds. You do not need to turn your drawings with this assignment.

**Guidelines:** Papers should be about 2-4 pages, double-spaced, 12 point font. Put the names of all members of your group on the first page, along with the name of your animal. Be sure to properly reference any sources you use, including a list of references at the end of your paper. Recall that it is very unlikely that you can over-reference a science paper, but very likely that you can under-reference. Err on the side of referencing! You may find that geography texts are very helpful. The internet may help a lot, too, but be careful that you are choosing reliable sources.

**Assignment #2**

In your first assignment, you established the environmental constraints for your animal. Now you are ready to begin to apply your knowledge of the function of particular systems to your animal design. For this assignment, you will design a method of thermoregulation for your animal. Taking into account the needs based on temperature fluctuations, availability of burrows or other hiding places, level of temperature homeostasis necessary for the function of your organism, etc., describe the mechanisms your animal uses to thermoregulate. Is your animal primarily a conformer or a regulator for temperature? Why?

In addition, it is time to get your animal to move. Will your animal use muscle-like structures or some other form of locomotion? Will your animal wait for prey to come near, or will it actively pursue its prey? Will it need extended activity, or short bursts of activity? Will it be able to get enough energy for this movement without overheating? Be sure to clearly explain the structure/function relationships you decide on for your animal. Are you sure these work within the environmental constraints you laid out in assignment #1? What are the energetic costs?

Finally, how does this animal reproduce? What are the energetic costs of that? Courtship behavior? Oviparity? Viviparity? Lots of small offspring or a few large? Parental care? Both parents? Be sure the reproductive strategy makes sense for the ecology/physiology of the animal.

Continue to work on your drawings of your animal as you add these systems. You do not need to turn your drawings with this assignment.

**Guidelines:** This addition to your animal design should be about 2-4 pages, double-spaced, 12 point font. You can append it to Assignment #1, integrating the two assignments as you see fit. Put the names of all members of your group on the first page, along with the name of your animal. Be sure to properly reference any sources you use, including a list of references at the end of your paper.

**Assignment #3**

In your first three assignments, you established the environmental constraints for your animal, designed a thermoregulatory system, and mechanisms for movement and reproduction. Now you need to consider sensory input to the organism. What kinds of information does your animal need? How hard it is to get? Will signals need lots of amplification? What are the energetic costs involved in getting and processing this sensory information? In addition, it is time to consider the input of energy to your organism. Its major food source(s) were listed in the original assignment. Give some detail now about how the animal gets that food.

Finally, what’s its evolutionary history? Geographically where did it come from? Where does it fit in on the vertebrate family tree? Is it a relatively new species or has it been around, unchanged, for awhile? When did it originate geologically? How do you know?

This is the last assignment page you will be given, so it is essential at this point that you finish your animal design by integrating the systems and considering the overall energetic costs to your organism

Continue to work on your drawings of your animal as you add the sensory systems. You do not need to turn your drawings with this assignment.

**Guidelines:** This addition to your animal design should be about 2-4 pages, double-spaced, 12 point font. Be sure to build on the ideas you presented in assignments 1-2. You can add features to your animal and modify existing features, but you have to keep what you already planned in the first two assignments. Put the names of all members of your group on the first page, along with the name of your animal. Be sure to properly reference any sources you use, including a list of references at the end of your paper

At this point, all 3 of the assignments should be integrated into a single document that reads as a coherent whole. You should clearly indicate sections of the document pertaining to different systems in your animal, but the systems can be (and should be) integrated in explanation and function.

**Final Presentation:** During the last lab of the term, your group will describe your animal to others in the class. You will be given 10-15 minutes to describe the animal. You might want to choose just a couple of systems to describe in depth, or a couple of original ideas for dealing with an environmental challenge that you are really proud of, or some really good way in which you have analyzed costs and benefits, or something else that you are most proud of about your animal. Ten minutes may not be enough time to describe all the work you have done on this, so choose carefully and rehearse your presentation. At this point, we want to see a picture of your animal. If you would like to use Powerpoint or some other technology you may, but you don’t have to.

**Descriptions of the Animals**

These are assigned one per team, at random.

**Description:** Your animal lives near the top of Mt. Fuji. This endothermic animal averages 8.5 kg in adulthood. It loves to terrorize hikers for fun. This organism is an herbivore. It is particularly susceptible to attack by mosquitos and related insects because it maintains a very high glucose content in its blood.

**Description:** Your animal lives in the Gobi desert, surviving mostly on insects. This ectothermic animal averages 0.8 kg in adulthood. It must watch out for snakes which enjoy eating it, and camels which tend to step on it.

**Description:** Your animal lives in the Amazon rain forest, hunting in the canopy for primates. This endothermic carnivore averages 36 kg in adulthood. It must watch out for poison frogs and tree snakes as well as avoid falling from the upper reaches of the canopy.

**Description:** Your animal lives in Lake Superior, surviving mostly on small amphibians it finds near the shore. This endothermic animal averages 16 kg in adulthood. It has a particular problem with barnacles living on its skin and causing open wounds which become infected and attacked by fresh water eels. It must also watch out for boats, which attack with propellers!

**Description:** Your animal lives next to a hot spring in a national park, surviving mostly on microorganisms. This endothermic animal averages 6.4 kg in adulthood. It must watch for bears, foxes, and other predatory mammals which eat these as yummy snacks. The other hazard it faces is trash from humans in the park, which looks tempting, but causes nasty stomach upset.

**Description:** Your animal lives deep in the ocean near a thermal vent. Almost no light penetrates to this depth. The animal survives on the vegetation and microorganisms of the thermal vent. This ectothermic animal averages 2.1 kg in adulthood. When really hungry, these animals become cannibalistic. It is particularly susceptible to excessive levels of metals in the water, which cause metabolic disturbances.

**Description:** Your animal lives in subway tunnels in New York City. It survives mostly on insects, mold, and any trash it can find, but its favorite food is decomposing mammal. This ectothermic animal averages 1.4 kg in adulthood. It must watch out for traps laid by humans, subway trains, the 3rd rail, cats, and snakes.

**Grading**

**Evaluation and Feedback Rubric Animal: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Vertebrate Design Project Names: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Assignments 1-3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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For each of the following Issues, each assignment has been rated on a scale of 0-3 with 3 meaning excellent, 2 meaning satisfactory, 1 meaning poor, and 0 indicating that this was not done at all.

**General issues (each assignment is graded on these):**

1. The paper is typed, double-spaced with the name of the organism and the creators on the first page.

2. The paper is properly referenced.

3. The animal is creative and imaginative, not just a reproduction of a real animal.

4. The descriptions include information about the relationships between problems and their solutions.

5. The paper reads as a cohesive whole, not a collection of pieces written by individuals.

6. The paper is grammatically well written and well organized.

**Grading specific to each assignment:**

1a.. The paper clearly and thoroughly describes the environment in which the animal lives, including water availability, average temperature and temperature fluctuation, food availability, shelter availability, and likely predators.

1b. The paper includes speculation about the potential problems this animal faces in daily survival.

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2a. The paper includes creative and effective method(s) of thermoregulation, appropriate for the environmental constraints and survival needs of the animal including a discussion of costs and benefits of this strategy.

2b. The paper includes creative and effective motor systems, appropriate for the environmental constraints and survival needs of the animal, including a discussion of costs and benefits of this strategy.

2c. The paper includes a creative and effective reproduction strategy for the animal, along with the reasoning behind this strategy, including a discussion of costs and benefits of this strategy.

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3a. The paper includes creative and effective sensory systems, appropriate for the environmental constraints and survival needs of the animal, including a discussion of costs and benefits of this strategy.

3b. The paper clearly and thoroughly describes the animal’s energy sources and methods of capture (and digestion, in general terms), including a discussion of costs and benefits of this strategy.

3c. The paper clearly describes a reasonable hypothesis about the evolutionary history of this organism, including explanations of why you think this.