

## Comparative Anatomy of Vertebrates *Adaptation to Land*

### Lab Assignment (60 pts)

**Due Thursday, 5 December by 1:00pm**

Turn in to Dr. Hirrel's Office, LSC 143 or to your lab instructor

Objective: This assignment is designed to assess your understanding of principles associated with vertebrate biology. As heterotrophs, vertebrates have to solve the same basic problems of (1) producing energy through aerobic respiration, and (2) reproducing. Thus, our study focused on the digestive, respiratory including the heart, urinary, and the reproductive systems. In general, your answers will relate to how the structure and function of the various organs found in these systems helps adapt vertebrates to life on land.

1(30 pts) Using your assigned organ (see diagram at end of this assignment) either:

1)Liver, 2) Small Intestine, 3)Kidney, 4)Heart

complete the following:

Your assigned organ is based on where you sit at your lab table

A (5). Briefly describe the function of your organ and indicate how the organ has been adapted for each animal.

B (10). From Table 1, construct a figure comparing your organ in all four animals.

C (15). Interpret your results and describe the organs adaptation relative to your answer in A.

Table 1. Comparison of organs and body mass for four vertebrate classes: Osteichthyes (fish), Amphibia (frog), Aves (bird), Mammalia (mammal) and. Data are the means and standard error from 8 lab groups. Means separated by 2 se units are significantly different.

	FISH		AMPHIB		BIRD		MAMMAL	
	x	se	x	se	x	se	x	se
Body wt. (g)	262.79	1.75	167.21	0.95	399.17	1.54	223.81	0.62
Digestive System								
Organ wt. to body wt. (%)								
small intestine	0.68%	0.12%	1.09%	0.04%	1.96%	0.03%	3.79%	0.03%
liver	0.76%	0.01%	2.31%	0.02%	2.89%	0.03%	4.70%	0.02%
Cardiac System								
heart	0.25%	0.05%	0.50%	0.06%	1.85%	0.11%	0.73%	0.03%
Respiratory System								
Gas exchange: gills, lungs	2.63%	0.04%	0.54%	0.02%	1.76%	0.02%	1.02%	0.01%
Urogenital System								
kidneys	0.18%	0.01%	0.54%	0.03%	0.45%	0.06%	0.98%	0.04%

2 (8 pts). Briefly explain how each animal (fish, frog, bird, and rat) accomplishes gas exchange needed for aerobic respiration. Relate the physiology of gas exchange to the activity of each animal relative to its habitat. Use Table 1, if needed, to justify your answer.

3. (8 pt). Draw a cladogram of the hearts and gas exchange organs for the classes of Fish, Amphibian, Reptile (Crocodile), Bird, and Mammal. Show the proper phylogenetic relationships between them with the most closely related next to each other and the least related the farthest away.

- Derived traits should be written along the branch to the group
- Conserved traits should be written below the diagonal trunk as common to several groups

4 (4 pts). Select either 4A or 4B to answer

A. As winter approaches, many animals are preparing to hibernate. Turtles are animals that hibernate underwater. Explain how a turtle manages to spend the entire winter submerged. Be sure to mention how respiration is accomplished.

B. Many organs in vertebrates come in pairs or have multiple parts, e.g. kidneys, lungs, reproductive organs, liver, etc. Briefly explain why having multiples of the same organ or multiple parts, like the lobes of the liver and lungs, is an advantage and why it could be a disadvantage.

5 (10 pt) The digestive system relates to an animal's metabolic rate and body temperature. Compare ectothermic vertebrates (fish and frog) to endothermic vertebrates (bird and rat) in relation to their metabolic rates as influenced by their habitat and how the relative size of the total digestive system is an adaptation for their metabolic rate.

- Write a null hypothesis based on relative size of the digestive system.
- Using the data below, construct a figure to compare means
- Write a brief conclusion of your results. Include your interpretation of the relationship between metabolic rate and the size of the digestive system.

Total Digestive System % of body wt.	REPS							
	1	2	3	4	5	6	7	8
FISH	3.16%	3.80%	3.58%	3.73%	4.22%	3.26%	3.50%	4.10%
FROG	7.49%	6.61%	5.71%	5.86%	6.49%	6.33%	7.54%	6.01%
BIRD	7.73%	8.23%	6.34%	8.57%	8.34%	9.62%	9.25%	8.14%
MAMMAL	11.16%	10.31%	11.44%	11.96%	11.72%	10.10%	11.45%	12.43%

Your organ is based on where you sit at your lab table

<b>Heart</b>	<b>Kidney</b>
<b>Small Intestine</b>	<b>Liver</b>

Front of lab