INDEPENDENT PROJECT I: DESIGN & IMPLEMENTATION

This project will involve your exploration of some anatomical feature of vertebrates and a poster presentation that reports your results. This project is *not a literature review* and will require both examination of anatomical descriptions in morphological literature and anatomical investigation of vertebrate specimens available to you in the laboratory.

SELECTING A PROJECT.

To begin you should select an anatomical structure in which you have some interest. You may choose any structure that is feasible to study within the limits of the facilities available at Regis and which is not explored in significant detail in lecture or laboratory. Paying some attention to function (or at least function as inferred from anatomical structure) will likely be important. The functional connection would be especially important for structures such as muscles for which function can be clearly inferred from structure.

You MUST clear your choice of structure with your instructor. No two groups of students may study the same structure.

Once you have selected your structure, you must propose an evolutionary hypothesis that you will test. Your hypothesis or question should be based on your knowledge of vertebrate relationships and anatomy. Keep in mind that your hypothesis can suggest that a structure will vary based solely upon function, based solely upon ancestry, or based upon some combination of the two.

Your hypothesis can be very general to start. However, it is expected that after some examination of specimens you will be able to propose a more refined hypothesis (see Table 1).

RESEARCHING BACKGROUND.

With any scientific study you must begin by looking into what already exists in the published literature. The best place for you to start will be your lecture textbook (and possibly your lab atlas). If your structure is not mentioned, then read about any associated structures. (E.g., If you are exploring the vasculature of the pancreas, then you should read about the pancreas AND the visceral vasculature in your lecture text and review the sections on the visceral vasculature of *Squalus acanthias*, *Necturus maculosus*, and *Felis cattus* in your lab atlas.) It is assumed that you have read and fully understand the pertinent sections of the textbook.

Table 1. Example initial student hypotheses and the refined hypotheses developed after examination of specimens and the primary literature.

Initial Hypothesis	Refined Hypothesis
More active vertebrates will have more extensive coronary blood vessels	Endothermic vertebrates, which typically have more active lifestyles, will have more extensive coronary vasculature and thus rely less upon oxygen from blood in the heart lumen than ectothermic vertebrates.
Tetrapod vertebrates that use their forelimbs for manipulation of objects will have more complex muscles in the forelimb.	Tetrapod vertebrates that typically move their manus with greater precision will have a more complexly divided forelimb musculature and these muscles will have longer tendons connecting to insertion points on the manus.
The ligaments supporting the liver in vertebrates will be most similar in closely related vertebrates regardless of how the vertebrates move.	Similarity in the position, number, and extent of hepatic ligaments in vertebrates will be similar among more closely related vertebrates and will not correlate with the type of locomotion utilized by the animal.

After reading what is available in the resources you purchased, you should proceed to the library. Do not let the age of some of the anatomical sources dissuade you. Unlike in molecular biology where resources more than a couple of years old are considered out of date, anatomical resources over a hundred years old are often better than some recent works as sources of information.

(WARNING: In some older sources, different names are given to structures based on past naming conventions or older hypotheses of homology. If confused about a term used in one of these works ask your instructor.) You should also look for any recent studies available through our online indexes (Cambridge Scientific Abstracts; Expanded Academic; Wiley Interscience).

For some organisms you should be able to get detailed anatomical information from the literature. I expect that you will get your data concerning human, *Homo sapiens*, anatomy from outside sources since we will not have access to a cadaver lab. The sources available on human anatomy should be sufficient for your purposes. The sources must be of sufficient detail to be considered academic (meaning greater detail than is presented in an undergraduate human anatomy textbook). Simply examining the human anatomy models available in the biology department will ***NOT*** be sufficient.

A type-written ***complete draft*** of your Introduction and Materials and Methods (with *at least* 5 academic sources cited in text and the full citations of these sources) will be due earlier in the semester to ensure that you have completed your background research early in the project and have examined enough specimens to refine your hypothesis.

GETTING STARTED.

For these projects you will likely need to examine as many species and individuals as possible. Any hypothesis about anatomical evolution requires the examination of a lot of animals to be reasonably supported (or rejected). Keep in mind that some species may be more readily available than others. The variety of whole preserved specimens will be greater than that of prepared skeletal material. Some material that Regis owns may not be available for dissection. If you are ever in doubt about whether or not you are allowed to dissect a specimen, WAIT AND ASK YOUR INSTRUCTOR. Additionally, do not expect to be able to convert whole preserved material into skeletal material. This process can take months depending on the size of the specimen being prepared.

YOU CANNOT BEGIN EXAMINING SPECIMENS TOO EARLY.

START LOOKING AT SPECIMENS AS SOON AS POSSIBLE EVEN IF YOUR HYPOTHESIS HAS NOT BEEN COMPLETELY "FLESHED OUT".

A COMPARATIVE ANATOMICAL STUDY REQUIRES A LOT OF SIMPLY LOOKING AT SPECIMENS AND NOTING DIFFERENCES.

You must use your **lab notebook** for gathering data. There are no specific requirements for the structure of this notebook (e.g., spiral bound, sewn binding, loose sheets in a binder). Your data should be gathered as sketches and descriptions. For each specimen examined you should:

1) Write the **scientific species name** of the specimen being examined.

2) indicate any **individual peculiarities** of each specimen. Is its coloration distinctive? Has it been damaged in some distinctive way (e.g., missing left hindlimb)? Is it labeled in some way? describe the features of your structure.

(It is not uncommon to have to re-examine specimens after you have looked at other species. Your perspective may change after observing how something varies in another species. Be certain that you gather and record as much general information as possible about each individual before you record your anatomical information.)

3) measure each specimen's **size**. [For lampreys use total length to measure size (length from tip of nose to tip of tail). For sharks use fork length to measure size (length from tip of rostrum to fork of caudal fin). For actinopterygiians use standard length to measure size (length

from tip of nose to distal edge of hypural plate). For non-mammalian tetrapods use snout-vent length to measure size (length from tip of nose to center of cloaca). For mammals use snout-anus length to measure size (length from tip of nose to anus).]

4) identify each specimen's sex and its reproductive condition, sexual maturity or what stage of sexual activity it is at. (e.g., pre-spawning female with ovary full of ova, pregnant female with embryos of about XXcm fork length) (Determining sex will be easy for specimens with clearly identifiable external genitalia. However, for some species you may have to examine their internal reproductive anatomy to determine sex. Reproductive condition will have to be determined internally. Determination of reproductive condition is most important for non-amniotes since these species usually have very pronounced seasonality and high fecundity.) remember that anatomy can vary based upon sex (sexual dimorphism) and can vary with season, especially reproductive season, as well.

5) indicate the anatomical preparation and preservation of each specimen. [Is it preserved in ethanol, Carosafe, Wardsafe, or some other substance? Has its vacular system been injected with colored latex? (Single injected = red or yellow arterial system; Double injected = red arterial system, blue venous system; Triple injected = red arterial system, blue venous system, yellow hepatic portal system)] Don't go crazy with this. A simple indication of kind of preservative is sufficient. Don't list all the ingredients in Carosafe or Wardsafe.

6) examine your structure and associated structures in the specimen. Sketch the structure and/or write a prose description of the structure. How is it shaped? How is it colored? To what is it attached and how?

The species of whole, preserved specimens that will be made available to you are listed below.

Class Petromyzontida
Order Petromyzontiformes
Petromyzon marinus, sea lamprey
Class Chondrichthys
Order Squaliformes
Squalus acanthias, spiny dogfish shark
Class Actinopterygii
Subclass Amiiformes
Order Amiiformes
Amia calva, bowfin
Subclass Teleostei
Order Perciformes
Morone americana, white perch
Perca flavescens, yellow perch
Pomadasys magranthus, Mexican grunt
Class Lissamphibia
Order Urodela
Necturus maculosus, mudpuppy
Order Anura
Rana catesbeiana, bullfrog
Class Reptilia
Subclass Testudinea
Order Cryptodira
Chrysemys sp., painted turtle
Subclass Lepidosauria
Order Iguania
Anolis carolinensis, American chameleon
Order Serpentes
Nerodia sp., water snake
Subclass Archosauria
Infraclass Crocodylia
Order Alligatoroidea
Alligator mississippiensis, alligator*
Infraclass Aves
Order Columbiformes
Columba livia, rock dove (pigeon)
Order Galliformes
Gallus gallus, domestic chicken**
Class Mammalia

Subclass Eutheria

Order Carnivora

Felis catus, domestic cat

Mustela vison, mink

Order Lagomorpha

Oryctolagus cuniculus, domestic rabbit

Order Rodentia

Rattus norvegicus, Norway rat

*The alligator specimen must be requested from the instructor and is not available for destructive examination.

**Additional specimens showing the musculoskeletal system and certain organs are available from grocery stores.

For each species examined you will want to examine as many individuals as possible. Do not be surprised if your anatomical structure varies **within** a species. This is not an uncommon occurrence. Be certain that you have some means of telling individuals apart. If the information on size, sex, and individual characteristics are not sufficient to tell individuals apart, label them.

You will likely want to examine all of the species available. However, your hypothesis or question may make that unnecessary. (For example, a study of knee joint anatomy would be useless on non-tetrapods and snakes.) If you do not examine one of the available species be certain that you clearly understand why you did not examine those species in light of your hypothesis/question. If you are only examining a few species (5 or fewer), then your hypothesis is evolutionarily too narrow for this project and you should expand it or devise another one.

DISSECTION.

When dissecting specimens you must try to do as little damage as possible. If the structure you need to dissect is bilateral, then dissect only the right side leaving the left side intact. The specimens you examine will likely be examined by the rest of the class. Treat them gently and try not to destroy something that someone else may need to examine. Use the dissection microscopes whenever appropriate. These microscopes **do not bite** and are designed to facilitate dissection of small specimens. Dissecting microscopes are simple to use and they **honestly will make structures more visible**.

If you need to remove something from a specimen to observe it, (1) make all of the observations you can with the organ or structure in place, (2) discuss with your instructor which specimens would be appropriate for destructive dissection, (3) discuss with your instructor when you should perform these dissections, and (4) replace the removed organs if possible, otherwise place them in labeled jars in preservative as directed by your instructor. Some specimens will not be available for this kind of dissection.

BEGINNING TO CONSIDER YOUR DATA.

An interpretation of your data may be obvious. However, rearranging your data can often make interpretation easier or allow you to see patterns that were not obvious otherwise. Some ways to look at your data are:

1. arrange rough drawings, descriptions, or summaries of the structures in various organisms in a table with organisms grouped taxonomically.
2. arrange rough drawings or very short descriptions of what varies along the top of the phylogenetic tree provided in the manual.
3. arrange rough drawings, descriptions, or summaries of the structures in various organisms in a table with organisms grouped based on pertinent qualities mentioned in your hypothesis. (Physiology, Diet, Function, etc.)
4. consider what anatomy would be intermediate between the anatomical forms you saw in the species you examined. Would these intermediates be functional?
5. consider how each type of structure would develop.

6. consider the natural history/ecology of the organisms examined and how that natural history would affect the functioning of your organ.

ADDRESSING YOUR HYPOTHESIS.

- REMEMBER that a single conflicting datum is enough to reject a hypothesis. If your hypothesis is that endothermic organisms will have only one of some kind of duct and ectothermic organisms will have two or more of some duct and your data agree except that the frog (an ectotherm) has only one duct, then you MUST say that your hypothesis is rejected. If you have some idea why the exception was an exception, you can then suggest a revised hypothesis that could be tested in the future.
- If your hypothesis concerns the correlation of a type of structure with a specific function, then the implication is that the similarity is due to function **NOT** due to ancestry. Therefore, finding two or more members of a closely related group that have differing function will be the best data to use for supporting or rejecting your hypothesis. (e.g., If all the mammals in your study exhibit a specific structure the simplest explanation is that they share it simply because they are mammals and not because they are functionally similar since many of the mammals examined may use the structure very differently.)
- Whatever your hypothesis is based upon be certain that you understand very well what characteristics each organism examined exhibits. For example, a study exploring the hypothesis that the liver will have a specific structure in endothermic organisms requires that you know about and can categorize the thermal physiology of all the specimens examined. This means that for this hypothesis you need to know, not only that birds and mammals are endothermic, but also more detailed facts about comparative vertebrate physiology. For this hypothesis this would mean that you would need to know that birds usually have higher metabolic rates and body temperatures than mammals and also that testudineans, lepidosaurs, and crocodylians (ectotherms) typically have a higher metabolic rate and usually regulate their body temperature to be higher than the lissamphibians (ectotherms). etc. You will likely have to do literature research to learn these things.
- Remember that the flexibility, texture, and especially the color of structures can be altered by the method of preservation and injection used. A red, blue, or yellow color could be the result of latex injection. Additionally, certain colors fade more rapidly in certain preservatives.

INDEPENDENT PROJECT II: POSTER PRESENTATION

The format of your poster presentation will approximate the format of articles published by scientists in professional journals. Scientific posters should be written in the clearest and most concise way possible. Long creative expositions meant to create an emotional setting are for short stories, poems and other types of creative writing. Coherence, brevity, consistent logic, and accurate representation of the study and its results are imperative. Use formal or semiformal language. Use of a relaxed tone, jargon, or slang is inappropriate in scientific writing. The words **I** or **we** are appropriate for use in scientific writing. However, the word **you** should not be used. There is no time in a scientific paper or poster when you would refer to the reader in such a way. The word "you" should NEVER be used to direct the reader in the Materials & Methods section (e.g., First *you* examine the ligamentous attachments.). You may use either first person active voice (e.g., We examined the ligamentous attachments.) or passive voice (e.g., The ligamentous attachments were examined.). Your instructor prefers first person active voice. However, some scientific journals, primarily British ones, do accept or even prefer passive voice. Keep the poster professional and DO NOT explain why you think the assignment is a wonderful (or horrible) experience or even refer to the fact that it was required for a specific course.

SECTIONS OF THE POSTER

TITLE—Compose a concise, descriptive title appropriate to the study that states your conclusion. See pp. 52-55 in *Writing Papers in the Biological Sciences, Third Edition*.

(do **NOT** begin this section with the word Title)

AUTHOR**S**—List your name and the name of your lab partner(s). Identify your affiliation as Regis University, Department of Biology.

(do **NOT** begin this section with the word Authors)

ABSTRACT—Compose a concise paragraph that summarizes your study. It should clearly contain your conclusion and a prose summary of the data supporting that conclusion. The abstract should be able to be understood by someone who has NOT read the rest of your poster. The maximum length of the abstract is 200 words. However, trying to stay at or below 150 words is even better. See pp. 55-59 in *Writing Papers in the Biological Sciences, Third Edition*.

(begin this section with the word **ABSTRACT**)

INTRODUCTION—You must give some background based on academic research (i.e., library research) to understand your study. There should be at least five (5) in-text citations of academic sources (excluding your textbook) in the introduction. The background should explain the hypothesis. (e.g., A hypothesis stating that a certain type of structure will correlate with diet should be preceded by background both on the structure and on the range of diet among vertebrates.) You must also clearly state the hypothesis or hypotheses that you tested and what reasoning led you to propose the hypothesis or hypotheses. See pp. 59-61 in *Writing Papers in the Biological Sciences, Third Edition.*

(begin this section with the word **INTRODUCTION**)

MATERIALS & METHODS—In this section mention what types of dissection if any occurred (gross or micro-). What types of specimens did you use (liquid preserved or skeletal preparations)? Indicate what you used to examine specimens (naked eye, hand lens, and/or dissection microscope). See pp. 61-66 in *Writing Papers in the Biological Sciences, Third Edition*. Unlike in cellular and molecular biology studies, this section can be rather short in anatomical studies.

(begin this section with the words **MATERIALS & METHODS**)

RESULTS— Provide a short, general verbal explanation of your results. You will need to generally explain the range of variation observed in your anatomical structure. Identify any anomalous observations. (E.g., The liver of the water snake, *Nerodia* sp., was unique in its structure….) This will be where you will cite your anatomical figures. However, you do not need to mention every observation in your prose. Give data tables or any other representation of your data if appropriate. Do not interpret your observations in light of your hypothesis or provide any general observations of correlation with other factors.

(begin this section with the word **RESULTS**)

DISCUSSION—This is the section in which you explain what your results mean.

(1) You **must clearly state if the data support or reject your hypothesis or hypotheses**. Explain **how** your data support or reject your hypotheses.

(2) You must also discuss what the variation you observed suggests about the evolution, function, development, or general range of variation of your organ or structure. Were there any interesting things you found that do not directly address your hypothesis?

(3) You should state how you could improve your current study. What additional things could you do to make your results more robust? (This will effectively be your "possible sources of error" section. However, you will not treat it in as explicit a manner as you would in an experimental study since you cannot include controls or vary experimental conditions in an anatomical study. Simply by stating what additional observations would be valuable, you identify the areas of current weakness in the support for your conclusions.)

(4) You should suggest either how you would continue the study or what would be another study that follows from something you discovered/observed in your study.

TIPS FOR INTERPRETING YOUR RESULTS IN THE DISCUSSION

- REMEMBER that a single conflicting datum is enough to reject a hypothesis. If your hypothesis is that endothermic organisms will have only one of some kind of duct and ectothermic organisms will two or more of some duct and your data agree except that the frog (an ectotherm) has only one duct, then you MUST say that your hypothesis is rejected. In your subsequent discussion you can state that with the exception of the frog, your hypothesis would have been supported. If you have some idea why the exception was an exception, you can then suggest a revised hypothesis that could be tested in the future.
- If your hypothesis concerns the correlation of a type of structure with a specific function, then the implication is that the similarity is due to function **NOT** due to ancestry. Therefore, finding two or more members of a closely related group that have differing function will be the best data to use for supporting or rejecting your hypothesis. (e.g., If all the mammals in your study exhibit a specific structure such as hair the simplest explanation is that they share it simply because they are mammals and not because they are functionally similar.) You should also present the data in a manner to emphasize the taxonomic grouping of organisms with differing functions.
- Remember that the flexibility, texture, and especially the color of structures can be altered by the method of preservation and injection used. A red, blue, or yellow color could be the result of latex injection. Additionally, certain colors fade more rapidly in certain preservatives. Feel free to mention such differences as data but you should also explain to the reader why you don't consider preservation effects to be significant or at least mention them as possible confounding variables.

(begin this section with the word **DISCUSSION**)

LITERATURE CITED—Any references that you cite in the text must be listed in the literature cited section. You will have at least 5 academic sources cited in the poster (excluding your textbook). When you take information directly from another source, you must give credit to the source providing that information. This includes reproduced figures which can be cited in the figure legend. Use the Name-Year System outlined in pages 107-125 of *Writing Papers in the Biological Sciences, Third Edition* or use APA style.

(begin this section with the words **LITERATURE CITED**)

ACKNOWLEDGMENTS— This short section recognizes those who assisted you in your research. You ***must*** thank or acknowledge the "Regis University Department of Biology for the provision of specimens and financial support for this research." DO NOT be silly or excessively grateful. You received help on a project not a new kidney.

(begin this section with the word **ACKNOWLEDGMENTS**)

GENERAL REQUIREMENTS:

- FIGURES & TABLES—All posters should have at least a few figures and most posters (if not all) should have at least one table summarizing the results. A graph is considered a figure.

  Figures – Figures must be numbered sequentially (Figure 1, Figure 2, Figure 3, etc.) and be cited in the text in that order. [e.g., The first figure cited in the text is (Fig. 1), the second is (Fig. 2), etc.]

  Figure legends must appear below each figure and must identify what is depicted. If an organism or dissection is depicted, the legend must include the scientific name of the species and clearly identify the structure and anatomical perspective. [e.g., **Figure 2** – Medial view of the superficial musculature of the right forelimb of *Columba livia* (the pigeon).]

  Tables – Tables must be numbered sequentially (Table 1, Table 2, etc.) and be cited in the text in that order. [e.g., The first table cited in the text is (Table 1), the second is (Table 2), etc.]

  Table legends must appear above or at the top of each table and must clearly identify what is reported in the table. [e.g., **Table 1** – Presence and extent of hepatic ligaments in vertebrate specimens examined for this study.]

- Use of the scientific names of organisms is required. (They were provided to you in the first handout.) Common names are allowed but are optional. Scientific names for species and genera must be *italicized* or otherwise set off from the text around them. The term "sp." means "undetermined species" and is not italicized. For example, *Chrysemys* sp. means an undetermined species in the genus *Chrysemys*. If you refer to humans, the scientific name is *Homo sapiens*.
- Your text must be grammatically correct and be free from spelling errors. A common mistake is treatment of the term data. The word **data is a PLURAL word.** (These data are…) and the word **datum is a SINGULAR word** (This datum is…).

CONSTRUCTION & APPEARANCE OF THE POSTER

- Posters must be completed on tri-fold board of the kind shown to you in class.
- Text must be "typed"/word processed and spaced in such a way that it is visually pleasing.
- The margins of text sections must be reasonable (probably 1"). No smaller than 0.5" and no greater than 1.25" for left and right margins or 1.00" for top and bottom margins.

- Use **a <u>minimum</u> of 18 point font for standard text. Twenty or 22 point may be better.** The title should be a minimum of 28 point font. The section headers (e.g., Introduction) should be a <u>minimum</u> of 24 point font.
- Use either Arial or Times New Roman font for the text. <u>Any text **on** a figure should be Arial or another similar sans serif font.</u> (Serf fonts have little "do dads" on the end of lines, e.g., **E** and sans serif fonts lack these, e.g., **E**.)
- <u>Figures must be included</u> and must be of high quality. ***<u>Use of crayon is forbidden.</u>***
- The title and authors must be at the top center of the poster.
- The poster must be arranged in a logical, easy to follow way, starting in the upper left and finishing in the lower right. [The abstract must be at the upper left (but below the level of the title and authors). The Literature Cited & Acknowledgements sections must be at the lower right.]
- Most posters are arranged where the reader reads down a series of 4-6 columns of text/tables/figures.
- All cut edges should be straight.
- Text, tables and figures should be printed on white or slightly off white paper. Visibility is of the utmost importance.
- Use complementary subdued colors. (For example: Any neon color is unacceptable. Maroon is better/more subdued than bright red.)
- Frame the text, tables, and figures with colored paper that complements the background color of the board. USE THE SAME COLOR FOR ALL FRAMING OF TEXT AND FIGURES. Remember that overall appearance IS part of the grade.

NATURAL HISTORY MUSEUM ASSIGNMENT

Answer the following questions based upon a visit to the Denver Museum of Nature and Science.

1. ENTRYWAY: Examine the *Tyrannosaurus rex* skeletal cast in the entryway. What are two characteristics synapomorphic of archosaurs **visible on this cast**? What are two additional characteristics uniquely shared by *T. rex* and modern birds (likely absent in crocodilians) **visible on this cast**?

2. MAIN ATRIUM (HANGING FROM CEILING): Examine the skeleton of the bowhead whale, *Balaena mysticetus*, (it may be a right whale, *Eubalaena glacialis*) hanging from the ceiling. What are three mammalian synapomorphies **visible on this skeleton**? (i.e., Whales are somewhat atypical mammals what are three skeletal characteristics that you could use to identify a whale skeleton as unambiguously belonging to a mammal?)

3. PREHISTORIC JOURNEY – DIVERSITY IN THE SEA: Examine the skeletal cast of the large placoderm, *Dunkleosteus* sp., in the plexiglass case. As the third major groups of gnathostomes (Chondrichthys, Osteichthys, and Placodermi), placoderms are particularly distinctive. Identify two distinct differences between placoderm demal bones and those of osteichthyans **visible on this skeletal cast**.

4. PREHISTORIC JOURNEY – FORESTS AND FLIGHT: Examine the skeletal cast of the fin backed amniote, *Dimetrodon* sp. This group of organisms is closely related to mammals. List the pectoral girdle bones **visible on this skeletal cast**. Identify at least one obvious similarity between these organisms and living mammals **visible on this skeletal cast**.

5. PREHISTORIC JOURNEY – TIME OF THE DINOSAURS 1: Examine the skeletal casts of a variety of dinosaurs. Do all dinosaurs have all the cranial fenestras typical of archosaurs? Provide the names of three dinosaurs with the name of the cranial fenestra(s) that is/are absent.

6. PREHISTORIC JOURNEY – TIME OF THE DINOSAURS 3: Examine the skeletal mounts of the large fish, *Xiphactinus* sp. Is this likely a teleost? What skeletal characteristics allow you to say that?

7. PREHISTORIC JOURNEY – TROPICAL ROCKIES: Examine the range of mammal skeletal specimens on display. Name at least four skeletal characteristics **visible on these skeletal mounts** that allow you to clearly identify these as mammals.

8. PREHISTORIC JOURNEY – EXPANDING GRASSLANDS: Examine the mammoth skeletons and skulls on display. Which teeth (incisors, canines, premolars, or molars) form the tusks? What anatomical characteristic allows you to make this determination?

9. HALL OF LIFE – HOW LIFE BEGINS: Examine the materials on human development. Evaluate how well or how poorly this part of the exhibit explains basic human anatomical development. Be specific.

10. HALL OF LIFE – ENTIRE EXHIBIT: Walk through the entire exhibit. Provide a thoughtful and specific critique (about a paragraph) of how the exhibit teaches about and entertains concerning human anatomy. Mention specific demonstrations/activities/exhibits. Provide one or more specific suggestions for how the exhibit could improve its treatment of anatomical material. (What could they add, change, etc.?.