APPENDIX E

INTERVIEW QUESTION POOL FOR ASESSING COMPETENCIES OF BIOLOGY SENIORS

Bloom's Levels I and II. Comprehension and Knowledge

- Hand the student a seed and stick of wood and ask where did most of the mass that is in the wood come from?
- What are the 12 nutrients required for maintenance and growth of living things?
- Identify at least two in Kentucky and explain why they are considered a keystone species. The beaver is because… The deer is because….

- Match the following common animals with the phyla to which they belong:

1. roundworm	a. Brachiopoda
2. segmented worm	b. Nematoda
3. clam	c. Chordata
4. bird	d. Bryozoa
5. coral	e. Echinodermata
6. sea star	f. Annelida
7. lampshell	g. Arthropoda
8. moss animal	h. Cnidaria
9. spider	i. Mollusca
10. flatworm	j. Porifera
11. sponge	k. Platyhelminthes
12. *Paramecium.*	l. Ciliophora

- Explain the different types of diabetes and explain how age determines how individuals are affected by the disease.
- What cell types are involved in the regulation of glucose in the blood? Which cell type deletion will lead to diabetes?
- What is natural selection? What are some other mechanisms of evolution?
- What is an "ecosystem"? Provide definition and an example.
- Explain the differences between eukaryotic and prokaryotic cells.
- The Calvin Cycle is a component of photosynthesis. How many times would this cycle have to turn to generate enough PGAL molecules to produce one molecule of glucose?
- Name the two processes which can form haploid gametes. What is the difference (s) between mitosis and meiosis?
- What are two requirements for a material to be classified as a genetic material? (answer: must be able to replicate itself and must direct what the organism is/does).
- Define homeostasis and give an example.
- Distinguish between the terms hypothesis and theory.
- Diagram and name the stages of mitosis of a cell which has 4 chromosomes.

- Evolution is defined as change in gene frequency over time. Identify and describe 3 ways in which evolution can occur, and provide a real or theoretical example of each.
- Describe the similarities and differences between natural lake, reservoir, and river ecosystems.
  Or depending on the student's ability or background,
  Describe the similarities and differences between terrestrial and aquatic ecosystems.
- The concept of evolution is the most important concept in biology, and along side the cell theory establishes the foundation of the science. However, mechanisms of evolution are still hotly contested. One mechanism, inheritance of acquired characteristics, proposed by Lamarck in 1809 is generally considered incorrect while inheritance by means of natural selection, proposed by Darwin in 1859, is generally accepted. Briefly describe how these two concepts differ.
- Describe the process of information storage and transfer in cells (ie. where is information stored and how does it get used in the cell?)
- Most of the genetic variety from higher organisms is a result of what phenomenon? Explain.
- People use the words data, hypothesis, theory and law; what do they mean?
- Describe the role of positive and negative controls in an experiment.
  How is the expression of a gene controlled?
- Alleles of a gene are often described as being recessive or dominant; what does that mean in terms of the activities of the gene products?
- Describe the changes in cellular physiology associated with the actions of a peptide hormone and a steroid hormone.
- What proteins are involved in skeletal muscle contraction? The events of muscle contraction are referred to as "sliding filaments". What does that mean?

Bloom's Level III. Application

- Hand the student a light bulb a piece of wire and a battery and ask them to light the bulb. Explain what causes the bulb to light up?
- Describe or illustrate the nitrogen, carbon, or sulfur cycle and explain how human impact may affect the cycle.
- Given that unimpeded population growth leads to exponential increase in population size, starting with one bacterium that divides every 20 minutes, how many bacteria would be present after 2 hours?
- Why do decomposition rates and rates of nutrient uptake by plants differ between for tropical agriculture?
- What is the difference between a large (e.g.???) and small (e.g., ???) ecosystem? Can you consider a reach of river as a separate ecosystem? (you may need to explain the term 'reach')? Support your argument with evidence. Is your argument compatible with your definition described above?
- You are about to sample insect diversity on two islands of equal size. However, one of the islands is twice as far from the mainland as the other. Based on what

you know about island biogeography which island would you expect to have greater insect diversity and why?

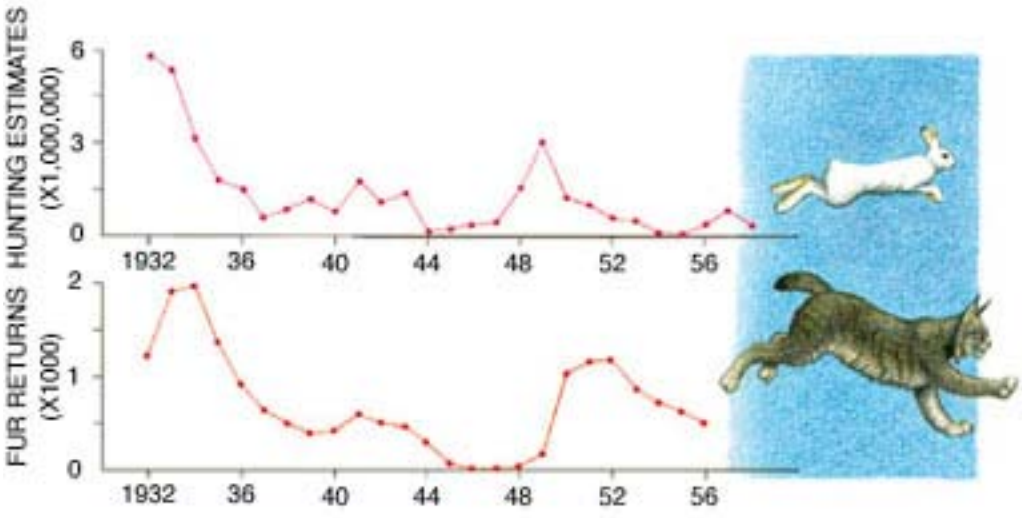
- Provide an analogy for an electron transport chain in cellular respiration?
- What physiological/behavioral adaptations for osmoregulation would you expect to find in a vertebrate that inhabits a freshwater environment?
- What would you recommend to someone who has been diagnosed as diabetic? List the various things a diabetic patient can do to maintain a healthy lifestyle.
- What blood types may arise among the children when a type A man marries a type B woman?
- Given a DNA strand and the genetic code, deduce the polypeptide that is produced.
- How could you use Mendelian genetics to explain the approximate 1 to 1 ratio of males to females in most species?
- Given that each cell of a developing embryo contains an identical set of gene, and given that genes influence the course of development, how is cell differentiation possible?
- Propose both a proximate and an ultimate explanation for autumn leaf drop.
- When an individual loses body mass, where does that mass go? (i.e., is it excreted? Evaporated?, etc.)
- Explain, in terms of energy sources and flows, why large predators are rarer (in terms of both types and population size) than their prey?
- If evolution leads to organisms that are well adapted to their environment, explain how it is possible that most species that ever lived are now extinct?
- John and Alice are siblings and both have a disorder which causes them to become extremely fatigued and short of breath after brief bouts of moderately intense aerobic activity. Their problem was discovered to be the result of a rare disorder in which there is a defective mitochondrial enzyme. If John gets married and has children, what is the probability that his children will have the same disorder? If Alice gets married and has children, what is the probability that her children will have the same disorder?
- Sickle-cell anemia is a deleterious mutation that persists in the human genome, why? Can you think of another example of host-parasite co-evolution? Can you think of other examples of heterozygous advantage?

Bloom's Level IV: Analysis

- Vioxx was recently pulled from the market for concerns over increased heart attack rates in the users. On what basis did the drug gain initial approval?
- Humans in industrialized nations are showing a trend in postponing reproduction until later in life and reducing the number of children they have. How might this trend affect human demographics? What are the economic and social concerns caused by this trend? Will this result in a decrease in the earth's human population?
- Diagram and explain the processes of mitosis and meiosis explaining the differences between the two with respect to chromosome behavior.

- What is the difference between a food web and a food chain? Why do ecologists need to know that difference…?

- How does insulin affect the glucose uptake through the receptor? What three tissue cells have been referred to as insulin target sites.
- If habitat A constituted 15% of available habitat, habitat B constituted 85%, and 75% of species iguana species X occurred in habitat A compared with 25% in habitat B, what would this suggest?
- Identify the assumptions of Hardy-Weinberg equilibrium. Explain H-W and explain how it is related to evolution. Give an example of a population in which one or more of the assumptions is violated? Explain how those assumptions are violated
- Give an example of trisomy and explain how that condition might come about.
- Explain the roles of DNA, genes, and chromosomes in evolution.



Graph Citation: http://www.lam.mus.ca.us/cats/P12/

- Data on Canadian lynx and hare populations often appear in ecology textbooks to illustrate relationships between predators and prey. What can you surmise about the interactions of lynx and hare from the data in this graph? What general theories have been derived from this study and others like it?
- Suppose you are serving on a jury. The case involves a woman with silicone-gel breast implants and connective tissue disease. She is claiming that the implants caused the disease. During the trial, you hear the testimony of 150 women with connective tissue disease, all of whom have silicone-gel implants. Is this convincing evidence that the implants caused the disease? If so, explain why. If not, then explain why not and identify other sort(s) of needed evidence.
- During embryonic development, a complex organism forms from a single cell, the fertilized egg. On the surface, this might seem to violate the laws of

thermodynamics, but in fact it does not. Explain how it is that embryonic development can occur without violating the laws of thermodynamics.

- Random events such as genetic drift, founder effects, and bottlenecks can influence evolutionary change in a population. How does this work, and can these processes produce traits that are not adaptive?
- There are traits that actually appear to be disadvantageous, such as the bright colors of various insects or the dramatic plumage of certain species of birds; how would you explain the presence of these traits in evolutionary terms?
- Suppose you are given two muscle samples from a lobster. The muscle fibers from the two samples are the same length. The fibers from one of the muscles are of larger diameter and have long sarcomere lengths, whereas the fibers from the other muscle are not as thick and have short sarcomere lengths. What could you infer about the contractile characteristics of the two muscles with respect to contraction strength and contraction speed?

Bloom's Level V: Synthesis

- Given that you can overcome most any technical hurdle, propose three solutions to our energy crisis.
- Select a biological concept at a micro- or macro- scale. What do you know about that concept? Give examples. From those examples, if you were to test the concept, what question would you test? How would you go about testing that question? Defend and justify why you conducted the research and why you believe it will be a valid and repeatable study.
- Based on your understanding of the process of meiosis and sexual reproduction, explain the main sources of genetic variability on which Natural Selection depends.
- Kentucky Lake Reservoir has very diverse communities of fish and freshwater mussels. What are some general biological and ecological concepts that might help explain this diversity?
- How does hyperglycemia associate with dysfunction and failure of various organs?
- The "Big Island" of Hawaii lies well within the tropics. It has areas with desert climate, tropical rainforest, and even snow on which people ski in winter. Where on the island would you expect each of these biomes to occur, and why?
- Based on your knowledge, what is your prediction on the future global climate? How could you determine the impact of global warming now? Could the outcome be positive or negative?
- You have been asked to test the effects of a new feed on weight gain in yearling calves. Using the scientific method outline the steps you would need to take to test the Hypothesis: New feed X produces a greater monthly weight gain in yearling calves than old feed Y (hint: stating the hypothesis is the first step).

- Why do animals and plants require nitrogen? Two common forms of nitrogen in the environment are ammonium (NH_4^+), and nitrate (NO_3^-). Which of these might be the preferred form of nitrogen for animals and plants? Why? What are you expecting from the students here?)

- President Bush proposed that plants be genetically engineered to use more carbon dioxide as a means of reducing global warming. What ecosystem-level impacts would you predict as a result of implementation of such a strategy?
- Three batches of radish seeds, each weighing 1.5 g, were obtained. Each batch was given a different experimental treatment:

1. Seeds <u>not moistened</u> (dry) placed in LIGHT;
2. Seeds placed on <u>moistened</u> paper towels in LIGHT
3. Seeds placed on <u>moistened</u> paper towels in DARK

After one week, all plant material was dried in an oven overnight (no water left) and plant biomass was measured in grams.

- <u>Predict</u> the biomass of the plant matter in each treatment.
  - light, no water
  - light, water
  - dark, water

The actual results are shown below

Dry biomass: 1.46 g 1.63 g 1.20 g

- Give an explanation for the results shown

- Hypothetical scenario: Grandma Johnson had very sentimental feelings toward Johnson Canyon, Utah, where she and her late husband had honeymooned long ago. Her feelings toward this spot were such that upon her death she requested to be buried under a creosote bush overlooking the canyon. <u>Trace the path of a carbon atom from Grandma Johnson's remains to where it could become part of a</u>

coyote. NOTE: the coyote will not dig up Grandma Johnson and consume any of her remains.

- Consider the following statement. Mutations occur at random, so it is not possible for natural processes to lead to an increase in information. Why is this statement false?
- While you are on the beach you notice that a nest of sea turtles has just hatched. The baby turtles head straight for the ocean as the crawl out of the sand, no matter which direction they are facing. Devise some experiments to determine how the turtles know which direction to go in order to reach the sea.

Bloom's Level VI: Evaluation

- I have a brief coverage of a CBS 60 minutes on mercury in dental amalgam. Please read this piece and comment on all the components of the scientific method reported here in terms of their appropriate use. You may mark on the article to highlights points you want to make.
- Discuss the ethical implications of cloning or stem cell research. Support each of your conclusions with evidence, if possible. State arguments for both sides and state your personal opinion at the end.
- The Endangered Species Act of 1973 protects species and provides funding to attempt to recover and reestablish rare and endangered species of wildlife and plants. Why do you think this is worth doing?
- How is it possible for global warming to create an ice age in parts of North America? Where do you want students to go with this question? – need a bit more here.
- You are in a townhall meeting and have to explain the importance of species diversity and conservation to participants. Why should we concern about the species diversity? What happens when a species disappears from an ecosystem? Do your efforts to save a species outbalance the economic benefits? You can use a hypothetical example, such as spotted owl vs. logging in Pacific Northwest, logging in Amazon rainforest, oil drilling in the Arctic Reserve, etc.
- Evaluate the application of the theory of island biogeography to conservation biology. What are the benefits of using the island biogeography approach to land preservation? What are the drawbacks? What other considerations should be taken into account when setting aside land for conservation? Can you think of another theory or idea in ecology that applies as well or better to conservation biology?
- The teaching of "evolution" in public schools has sometimes caused controversy, especially in the southeastern U.S. In Cobb County, near Atlanta, some biology textbooks carry a sticker that warns "evolution is a theory, not a fact." A group of Cobb County parents has sued the school district, charging that it has mingled religion with science by using the sticker.
- Without debating the scientific or religious evidence for or against evolution, what are some of the issues raised for the teaching of biological concepts by the use such a sticker?

- You are getting a degree in biology, the study of life. Argue for and against the statement: “Viruses are alive.” Support your arguments with evidence.
- How important is the discovery of either a. the genetic code or b. the complete sequence of the human genome to science? Support your arguments with evidence.
- How do culture, prejudice and personal idiosyncrasies influence science?
- What is the most important thing that you learned from your ECOLOGY class (if you'd taken – or another key course)? How could apply it under... situation?
- The US Congress has just passed a law, which makes the cloning of your own organs legal. Would you participate in the cloning of your own organs? Why or why not? What are the ramifications of this law? Are there any regulatory stipulations that should be attached to the law?