MULTIPLE CHOICE.—For the following multiple choice questions circle the letter in front of the response that best answers the question or completes the sentence. (10%, 1% each)

1. Which of the following is a sphincter between the stomach and the duodenum?
   a. cardiac sphincter
   b. esophageal sphincter
   c. ileocecal sphincter
   d. pyloric sphincter
   e. None of the above

2. Which of the following is simply a hollow mass of cells?
   a. blastula
   b. gastrula
   c. morula
   d. neurula
   e. None of the above

3. Which of the following is an immobile blood clot?
   a. aneurysm
   b. embolus
   c. infarction
   d. thrombus
   e. None of the above

4. Which of the following is NOT a type of connective tissue?
   a. adipose (fat) tissue
   b. blood
   c. bone
   d. tendon
   e. None of the above (all are connect. tissue)

5. Which of the following is the correct order of vertebrate development?
   a. zygote → blastula → morula → gastrula
   b. zygote → gastrula → morula → blastula
   c. zygote → gastrula → blastula → morula
   d. zygote → morula → blastula → gastrula
   e. None of the above (all are incorrect)

6. In a mammal, blood from the right ventricle, then flows to the...
   a. aorta.
   b. inferior vena cava.
   c. left atrium.
   d. left ventricle.
   e. None of the above

7. Which of the following is where urine is collected in the kidney?
   a. renal cortex
   b. renal medula
   c. renal pelvis
   d. urinary bladder
   e. None of the above

8. Which of the following most directly results in a chemical change in the vitelline layer of an ovum?
   a. acrosomal reaction
   b. cortical reaction
   c. membrane depolarization
   d. nuclear fusion
   e. None of the above

9. Why does infection with Vibrio cholerae result in dysentery (diarrhea)?
   a. The colon is damaged by exotoxin.
   b. The gallbladder is damaged by exotoxin.
   c. The pancreas becomes inflamed.
   d. The stomach begins to digest itself.
   e. None of the above

10. The central nervous system is formed by the folding in of which type of tissue?
    a. ectoderm
    b. endoderm
    c. mesoderm
    d. notochord
    e. None of the above
MATCHING.—For the following exercise match the negatively affected organ in the right column with the disease or disorder in the left column. Each letter may be used more than once or not at all. (5%, 1% each)

1. common cold  ______
2. heartburn  ______
3. pneumonia  ______
4. stroke  ______
5. tuberculosis  ______

FILL-IN-THE-BLANK.—For the following exercises write the appropriate word or words in the available space.(12.5%)

1. Fill in the appropriate labels for the following drawing. (5%)

```
A
B
C
D
E
```

2. The three functions of the lymphatic system are… (1.5%)

```
__
__
__
```

3. Fill in the appropriate labels for the following drawing. (4%)

```
A
B
C
D
```

4. List four diseases, disorders, or groups of diseases that occur at an increased frequency in someone who smokes. (2%)

```
__
__
__
__
```
DEFINITIONS.—For the following BIOLOGICAL words or phrases define them as accurately and concisely as possible. (20%, 4% each)

1. African sleeping sickness:

2. Guinea worm:

3. heart attack (myocardial infarction):

4. meroblastic cleavage:

5. nephron:

LONG ANSWER.—For the following answers, address each question in as concise and lucid a manner as possible. Do NOT exceed the space provided. (15%)

1. Explain how human blood sugar is regulated? What happens in Type 1 Diabetes Mellitus? What happens in Type 2 Diabetes Mellitus? (5%)
2. A single *Streptococcus pyogenes* bacterium infects Edith's throat. Two weeks later Edith shows strep throat symptoms and goes to her physician who prescribes penicillin to be taken for three weeks. Edith is quite optimistic since she has had strep throat in previous years and it has always cleared up after her physician prescribed penicillin. Edith feels well after a week and stops taking the antibiotic. Two weeks later Edith's strep throat symptoms return. She takes her remaining two weeks worth of penicillin and feels fine. However, two weeks after her last penicillin pill she once again develops strep throat symptoms. (7%)

a.) **Describe in one short sentence** what you know about the shape, arrangement of the cells, and cell wall structure of *Streptococcus pyogenes*.

b.) Draw an approximate graph of the population size of *Streptococcus pyogenes* in Edith from the initial infection to two weeks (before she starts taking penicillin). What type of population growth is this?

c.) Explain what may have happened that could have caused Edith's strep throat relapses. (Assume that re-infection from another person or the environment DID NOT occur.)

d.) Briefly explain what mistakes Edith and her physician made.

3. Explain why your stomach doesn't normally digest itself? (3 reasons) (3%)
MULTIPLE CHOICE.—For the following multiple choice questions circle the letter in front of the response that best answers the question or completes the sentence. (10%, 1% each)

1. In a population at **Hardy-Weinberg equilibrium**, if the frequency of AA is 0.16, then what is the frequency of aa?
   a. 0.36
   b. 0.60
   c. 0.64
   d. 0.84
   e. None of the above

2. Is a population with the following genotype frequencies at Hardy-Weinberg equilibrium? AA=0.40, Aa=0.20, aa=0.40
   a. no
   b. yes
   c. unable to determine from given data

3. A population of 1000 ferns undergoes **exponential growth** with a yearly intrinsic rate of increase of 0.4, then what is the size of the population after **2 years**?
   a. 1200
   b. 1400
   c. 1800
   d. 1860
   e. None of the above

4. If a population of 1000 rats in an environment with a carrying capacity of 2000 is undergoing **logistic growth** with a yearly intrinsic rate of increase of 0.5, then what is the population size after **1 year**?
   a. 1050
   b. 1250
   c. 1500
   d. 2000
   e. None of the above

5. You put a nail 2 m above the ground in a tree that grows 2 m taller per year. How high is the nail after 3 years?
   a. 4 m (meters)
   b. 6 m (meters)
   c. 8 m (meters)
   d. 10 m (meters)
   e. None of the above

6. Which of the following is **FALSE about a flowering plant**?
   a. It can produce a fruit.
   b. Female gametophytes have few (4-12) cells.
   c. Male gametophytes grow to reach female gametophytes.
   d. The embryo in the seed uses the female gametophyte for nutrition.
   e. None of the above (all are true)

7. Which of the following best describes **pollen**?
   a. A baby plant in a box with its lunch
   b. Airborne plant sperm
   c. Mobile microsporangium
   d. Small male gametophyte
   e. Sporophyte

8. Which of the following have **radial symmetry as adults**?
   a. earthworms
   b. flatworms
   c. roundworms
   d. sponges
   e. None of the above (all are not radial)

9. Which of the following describes **E.coli** living "happily" in your colon and producing vitamin D for you?
   a. Commensalist
   b. Mutualist
   c. Parasite
   d. Parasitoid
   e. Predator

10. Which of the following is a correct **species** name?
    a. Giardia
    b. lamblia
    c. Giardia lamblia
    d. Giardia Lamblia
    e. None of the above
MATCHING.—Match the organism in the right column with the corresponding taxonomic group in the left column. Each letter may be used more than once or not at all. (5%, 0.5% each)

1. Annelida  ______  ______  A. barnacle
2. Arthropoda  ______  ______  B. clam
3. Molluska  ______  ______  C. earthworm
4. Nematoda  ______  ______  D. fluke
5. Platyhelminthes  ______  ______  E. hook worm
                                          F. leech
                                          G. ring worm
                                          H. round worm
                                          I. spider
                                          J. squid
                                          K. tapeworm

FILL-IN-THE-BLANK.—For the following exercises write the appropriate word or words in the available space. (10%)

1. Sketch a graph of human population growth over the last 4000 years. (1%)

2. What are the two greatest threats to biodiversity & endangered species? (2%)

______________________________
______________________________

2. Fill in the blanks below. (1.5%)
The three DOMAINS of life are…
______________________________
______________________________
and______________________________.

3. The class that includes the ray-finned fishes is _________________. (1%)

4. Label synapomorphies for the indicated branches below (3%)

   Plantae  Fungi  Animalia
   A
   B
   C

   a. ________________________
   b. ________________________
   c. ________________________

5. Sketch and correctly label a biomass pyramid (NOT a food chain) for a typical ecosystem. Be certain to include at least three trophic levels. (1.5%)

   ______________________________
DEFINITIONS.—For the following words or phrases define them as accurately and concisely as possible. (10%, 2% each)

1. behavioral imprinting:

2. bottleneck effect:

3. empirical (empiricism):

4. monophyletic group:

5. sporophyte:

SHORT ANSWER.—For the following answers, address each question in as concise and lucid a manner as possible. Do NOT exceed the space provided. (5%)

1. Compare and contrast natural selection and genetic drift. What does each do? In what does each result? (3%)

2. Explain why saying that something evolved "for the good of the species" is INcorrect. Why would a trait that was good for perpetuating the species but bad for the survival or reproduction of the individual possessing it not persist in a population? (2%)
**SHORT ESSAYS.**—For the following essays, address each question in as concise and lucid a manner as possible. Do NOT exceed the space provided. (10%)

1. A friend tells you a fantastic story. Over break she said she went to an island off Hawaii where she got lost for 3 days. In this hot, moist tropical environment she was only able to survive by eating the seeds and fiddle heads of native tree ferns and resting in the shade of a group of luxuriant mosses. Her family finally found her sitting on the beach with fern flowers in her hair in the shade of a large conifer gametophyte. Explain how your friend's story indicates that she does not know much about plants. (5%)

2. Construct a phylogeny of the following reptiles based on the data below. (Numbers indicate characteristics of the organisms.)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snake</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Monitor Lizard</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gecko</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skink</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Iguana</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuatara - outgroup</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A systematist recognizes a taxonomic group **Lacertilia** including monitor lizards, geckos, skinks, and iguanas and recognizes snakes in their own separate group **Serpentes**. What type of a systematist is this and how do you know? (5%)