True or False (write ‘true’ or ‘false’; 7 points total; 1 point each)

1. ______ The troposphere is closer to the earth than the stratosphere.

2. ______ The north and south facing walls atop the Gould-Simpson building receive different amounts of solar radiation.

3. ______ More water is precipitated on the oceans than is evaporated from the oceans over the course of a decade.

5. ______ About 95% of the global increase in human population expected to occur in the next 30 years will take place in developing countries.

6. ______ Genetic mutation is the ultimate source of all biological variation.

7. ______ In the biosphere, matter is recycled but there is a one-way flow of energy.

Multiple Choice (questions have only one correct answer; 8 points total; 2 points each)

1. Current human population is closest to

   a) 3.2 billion,  b) 4.2 billion,  c) 5.2 billion,  d) 6.2 billion,  e) 7.2 billion.

2. Roughly what percent of the solar radiation that strikes the earth is used in photosynthesis and ultimately provides the overwhelming majority of biomass that sustains life on this planet?

   a) 1%,  b) 5%,  c) 10%,  d) 25%,  e) 50%

3. The most dangerous threat to biodiversity is

   a) alien species,  b) disease,  c) pollution,  d) habitat loss,  e) over exploitation

4. On average, what percent of the useful energy in organisms at one trophic level is passed on to the next, higher trophic level?

   a) 4%,  b) 10%,  c) 16%,  d) 18%,  e) 22%


*Fill in the Blank* (2 points per blank; 26 points total)

1. Niche is to ___________________________, as “job” is to “address”.

2. CO$_2$ + H$_2$O + ___________________________ energy $\rightarrow$ C$_6$H$_{12}$O$_6$ + ___________________________ in a process known as ___________________________.

3. The two abiotic factors that are most responsible for the distribution and abundance of life on earth are ____________________________, and ____________________________.

4. Life first evolved on this planet about 3.5 ______________________ years ago.

5. ____________________________ is an example of a perpetual resource. ____________________________ is an example of a renewable resource.

6. A generalist species (e.g., cockroach or coyote) has a ____________________________ niche. A specialist species (e.g., giant panda) has a narrow niche.

7. The three important characteristics of pollution are its 1) chemical composition and activity, 2) ____________________________, and 3) ____________________________.

8. Ocotillos are a unique local plant. What other unusual species found on campus is a close relative of the ocotillo (both are in the family Fouquieriaceae)? ____________________________.
Really Short Answer (not more than a sentence; 28 points total; 3.5 points each)

1. List two conditions that contribute to the success of invasive species. Are all alien species invasives?

2. How are fecundity and natural selection related?

3. In Aldo Leopold’s essay Thinking Like a Mountain, what happens to the ecosystem that loses its top predators (e.g., wolves)?

4. Why is the concept of effective population size important in the context of conservation biology?

5. Define fitness in the sense used by evolutionary biologists.

6. Why is genetic variation thought to be important for long-term persistence of populations of plants and animals?

7. Answer A or B. A) List two adaptations that plants have for existence in arid environments. B) List three of the four mountain ranges surrounding Tucson.

8. Explain ‘Tragedy of the Commons’ in terms of costs and benefits. Please give an example of a tragedy of the commons.
Short Answer (30 points total; 6 points each; a few sentences required for an adequate answer)

1. List each of the terms in the IPAT model and describe differences between developed and developing countries.

2. Answer A or B.  A) How does our use of fossil fuels alter the natural carbon cycle?  
   B) What important role do nitrogen fixing bacteria (like *Rhizobium* spp.) play in the nitrogen cycle?

3. For which of the following graphs is it more likely that natural selection for bigger beaks will cause bill size to change over time in the population.  Why?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>beak size in the parents</td>
<td>beak size in the parents</td>
</tr>
<tr>
<td>beak size in the offspring</td>
<td>beak size in the offspring</td>
</tr>
</tbody>
</table>
4. Answer A or B.
A) With respect to native grasses near Fort Huachuca, what did Guy McPherson indicate was the importance of considering the month of the year during which fires burn?
B) Define species richness and describe how species richness is related to the density of introduced Lehman Lovegrass near Fort Huachuca.

5. On the top axes, draw the distribution of beak sizes you might expect to see on an island with only one recently arrived bird species and abundant food supplies. **Be sure to label your axes appropriately.**

On the bottom axes draw the distribution of beak sizes after 10-20 generations following A) directional selection for smaller beaks, and B) disruptive selection for beak size.

(this question is worth 7 points)
A rare Extra Credit opportunity:
Read the Dr. Seuss book The Lorax. If, by 9am Monday of next week, you turn in a typed, one page summary and interpretive essay you may receive up to 5 points toward your Exam I grade.