You MUST know:
1. Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.
2. Organisms respond to changes in their external environments.
3. Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues, and organs.
4. Organisms exhibit complex properties due to interactions between their constituent parts.
5. Cooperative interactions within organisms promote efficiency in the use of energy and matter.
6. Variation in molecular units provides cells with a wider range of functions.
7. Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.
8. Biological systems are affected by disruptions to their dynamic homeostasis.
9. Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.
10. Individuals can act on information and communicate it to others.
11. Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms.
12. Timing and coordination of physiological events are regulated by multiple mechanisms.
13. Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.
14. Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.
15. Interactions between molecules affect their structure and function.
16. A variety of intercellular and intracellular signal transmissions mediate gene expression.
17. Cell communication processes share common features that reflect shared evolutionary history.
18. Cells communicate with other cells or from a distance via chemicals.
19. Cells communicate with each other through direct contact with other cells or from a distance via cell signaling.
1. List the systems that had to evolve to support cellular respiration in multicellular animals? (3 at least)
   a. 
   b. 
   c. 

2. List the systems that either evolved by piggybacking on the ones above or evolved to compensate for potential problems caused by the systems listed above. (3 at least)
   a. 
   b. 
   c. 

3. Structure/function: List all the adaptations that increase surface area in animal systems and explain why increased surface area improves the function of that system. (7 at least)
   a. 
   b. 
   c. 
   d. 
   e. 
   f. 
   g. 

4. Structure/function: List all the countercurrent exchange systems used in animal systems and explain the adaptive advantage of each. (3)
   a. 
   b. 
   c.
5. **Structure/Function**: List as many molecular examples of structure fits function as you can. (5)
   a. 
   b. 
   c. 
   d. 
   e. 

6. **Structure/Function**: List as many cellular examples of structure fits function as you can (include organelles). (5)
   a. 
   b. 
   c. 
   d. 
   e. 

7. **Structure/Function**: List as many organ or system examples of structure fits function as you can (5)
   a. 
   b. 
   c. 
   d. 
   e.
8. Movement across a membrane: List all the systems in which some component is based on movement of material across a cell or organelle membrane. List whether the movement is diffusion, osmosis, active transport, or bulk flow. Describe the adaptations that increase the efficiency of this movement (7)
   a.
   b.
   c.
   d.
   e.
   f.
   g.

9. Cell to cell communication: List all the systems in which some component is based on cell-to-cell communication and explain how this is accomplished. (3)
   a.
   b.
   c.

10. Conformational change: List all the systems in which some component is based on conformational changes in proteins (4).
    a.
    b.
    c.
    d.

11. Explain the role of each of the following to its support of photosynthesis and respiration in plants:
    a. Roots
    b. Stem
    c. Leaves
12. List the adaptations that allow plants to accomplish each of the following aspects of their physiology
   a. Defense
   b. Responses to the environment
   c. Reproduction

13. Evolution: List the adaptations of plants that enable them to live on land in general, or in particular biomes in specific (3)
   a. 
   b. 
   c. 

14. Structure/Function: List all the examples of transport in plants that are due to differences in osmotic potential in different areas of the plant. Describe the adaptations that increase the efficiency of this movement (2)
   a. 
   b. 

15. Structure/Function: List as many molecular examples of structure fitting function in plants as you can (2)
   a. 
   b. 

16. Structure/Function: List as many structure fitting function in plants as you can (include organelles) (2)
   a. 
   b. 

17. Interconnectedness: List as many examples where symbiosis between plants and other organisms enables plants to accomplish vital aspects of their physiology either entirely, or more efficiently, identify the symbiotic partner in the relationship, and give an example of a plant who engages in this symbiosis (2)
   a. 
   b.
18. What key events occur at each stage of development?

<table>
<thead>
<tr>
<th>Developmental stage</th>
<th>What occurs during this stage</th>
<th>What is the influence or effect on the subsequent development of the embryo?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Cleavage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Blastula formation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Gastrula formation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Organogenesis (example neural tube formation)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19. Diagram the path a red blood cell takes from a capillary in your big toe to your heart and back to your big toe. At each point in the pathway, indicate whether the red blood cell is picking up or losing oxygen. Indicate also the relative blood pressure each will likely have. Include the following terms (aorta, venules, veins, arteries, arterioles, capillaries, right atrium, left atrium, right ventricle, left ventricle, coronary arteries, heart, internal organs, skeletal muscle)
20. Fill in the table

<table>
<thead>
<tr>
<th>How do phototropism and photoperiodism differ?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>What light characteristics would you use to maximize plant growth per unit time?</td>
<td></td>
</tr>
<tr>
<td>What kind of physical environment would you need to maintain appropriate phototropic responses among plants?</td>
<td></td>
</tr>
<tr>
<td>What design modifications would you need to make to support plants with different photoperiods – for example long-day versus short-day plants?</td>
<td></td>
</tr>
</tbody>
</table>

21. To remain alive an organism must be able to maintain homeostasis of its internal environment relative to the external environment. What behaviors, structure(s), or system(s) are of primary importance in maintaining homeostasis in the following situations in amoeba versus mammal?

<table>
<thead>
<tr>
<th>Situation</th>
<th>Amoeba</th>
<th>Mammal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in environment, pH, or temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reception of a stimuli, (light or touch)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to stimuli</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

22. What is the overall function of digestion?

23. How do bacteria eat?

24. How do amoebas eat?