Respiratory System Comparative Anatomy Lab

Pre-Lab Questions

1. What are the main structures of the respiratory system?

2. Why do we need to breathe in order to survive?

3. How do you think the respiratory system of mammals, birds, reptiles, amphibians and fish differ?

Demonstration: Respiration in Humans The volunteer will take a deep breath of air and exhale through a straw into bromothymol blue solution. Then they hold their breath for 30s and repeat into a second container.

<table>
<thead>
<tr>
<th>Color of solution before the exhalation</th>
<th>Color of container 1 after resting exhalation</th>
<th>Color of container 2 after the volunteer holds their breath for 30 seconds and exhales</th>
</tr>
</thead>
</table>

4. What do you think led to the color change in the container? What might lead to a difference in color between the containers after the person holds their breath?
Station 1: Respiration in Fish:
Read the page 491 in the green textbook

5. Explain how gills work

6. Predict why do gills need so much area in order to function?

Station 1.5: Respiration in Fish-Observations:
Head to the dissection scopes! Do not touch other than the fine focus.
Observe the gills of the fish under the dissecting scope.

7. Draw and label what you observe below.

Station 2: Endotherms and Ectotherms:

8. Fish are ectotherms. How do ectotherms differ from endotherms? (p. 571 green book)

9. What are the benefits and drawbacks of being an endotherm?

10. Do ectotherms or endotherms need to eat more food? Why?
**Station 3: Comparative Anatomy of the Respiratory Systems of Vertebrates: Use the larger diagram print outs to fill in the chart**

<table>
<thead>
<tr>
<th>Organism</th>
<th>Picture</th>
<th>Ectotherm or Endotherm?</th>
<th>Similarities between structures</th>
<th>Differences between organisms and how they work</th>
<th>Prediction: Selective mechanism(s) that could have led to these structures.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td><img src="image" alt="Fish Diagram" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frog (Amphibian)</td>
<td><img src="image" alt="Frog Diagram" /></td>
<td></td>
<td></td>
<td>Cutaneous Respiration:</td>
<td></td>
</tr>
<tr>
<td>Reptiles (Lizard)</td>
<td><img src="image" alt="Reptile Diagram" /></td>
<td></td>
<td></td>
<td>(in comparison to frogs):</td>
<td></td>
</tr>
<tr>
<td>Bird</td>
<td><img src="image" alt="Bird Diagram" /></td>
<td></td>
<td></td>
<td>Air sacs:</td>
<td></td>
</tr>
<tr>
<td>Mammals</td>
<td><img src="image" alt="Mammal Diagram" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Analysis questions on back**
Analysis:

1. What are some major trends you see in the evolution of the respiratory system?

2. What type of selective pressures could have cause fish to evolve lungs?

3. What type of selective pressures could have made birds need better oxygen efficiency?

4. How do you think the evolution of the respiratory system connects to the circulatory system?

Discussion notes:
Gills are respiratory organs found in many aquatic organisms that extract dissolved oxygen from water and excrete carbon dioxide. Gills usually consist of thin filaments of tissue, branches, or slender, tufted processes that have a highly folded surface to increase surface area. A high surface area is crucial to the gas exchange of aquatic organisms, as water contains only a small fraction of the dissolved oxygen that air does.
Cutaneous Respiration: In addition to inhaling and exhaling air through their lungs, many amphibians rely on cutaneous respiration, where gas exchange occurs through the skin. In order for cutaneous respiration to be efficient, the skin must remain moist.
All reptiles breathe using lungs. Lung ventilation is accomplished differently in each main reptile group. In squamates (scaled reptiles—the largest group), the lungs are ventilated almost exclusively by the axial musculature. This is also the same musculature that is used during locomotion. Because of this constraint, most squamates are forced to hold their breath during intense runs. Other reptiles have other adaptations for breathing (for example, crocodiles use a diaphragm that is analogous to the diaphragm in humans while turtles and tortoises use other muscles to allow breathing with a rigid shell).
Respiration in Birds

Air Sacs: When birds inhale, the air first travels to the posterior air sacs. Next, it travels to the lungs through a series of breathing tubes. Stale air travels to the anterior air sacs, which is then exhaled. This system of air sacs and breathing tubes allows air to flow through the lungs in a single direction enable birds to remove oxygen from the air when they inhale AND when they exhale. This is different from most vertebrates that have air traveling through the lungs in two directions (in and out). This system is highly efficient and enables birds to maintain a high metabolic rate.

Ask teacher to play video on the screen
Mammals inhale by contracting the diaphragm, which increased the size of the chest cavity causing air to rush into the lungs. There, the air enters the alveoli. This creates a high concentration of oxygen in the alveoli, the oxygen will diffuse into the blood stream through the capillaries. Inside the blood there is a high concentration of carbon dioxide, so the carbon dioxide diffuses into the alveoli. The diaphragm then relaxes and the pressure forces the air out the lungs.