The Norway rat (Ratus norvegicus) belongs to the family Muridae, a large group of rodents that includes the house mouse, gerbil, and hamster. The rat occupies a wide range of habitats in association with humans. In the wild, this rat is well known for the problems that it causes. It eagerly consumes fruits and grains intended for human consumption, attacks small farm animals, and frequents garbage-strewn alleys and crowded urban situations. On the other hand, inbred strains of rats are invaluable as mammalian models in medical research, and the specimen that you are dissecting is from one of those strains.

Why dissect a rat? The Norway rat is commonly used in studies of comparative anatomy, because it displays the typical mammalian body plan. In other words, what you learn by dissection of the rat is broadly applicable to most other mammals. Even if your primary interest is human anatomy, the rat is very similar in construction, and most of the names that you will learn apply to human structures as well.

After studying the external anatomy and removing the skin, you will organize your dissection by considering the anatomy of the important body cavities – thoracic, abdominal, pelvis and cranial. You will identify the organs/structures in those cavities and determine the organ systems to which they belong. Although you cannot see actual physiology in a dead (and, therefore, non-functioning) organism, you will begin to consider the functions of the organs and organ systems that you observe in this dissection.

Focus Questions

- What are the basic anatomical terms?
- What are the organ systems in the rat, where are they located and what do they do?
- How do these systems relate to human systems?
- What are the techniques for proper laboratory dissection?

General Lab Instructions

Beginning of each dissection day:
- Obtain rat, gloves, aprons, and materials.

During each dissection:
- Follow specific instructions for each dissection section. Read all directions before beginning.
- Cut as little as possible as any cuts will alter the original structural relationships.
- Observe and identify before you draw.
- Complete all drawings in pencil. Drawings must include a date, title and scale.

End of each dissection day:
- Wrap the rat in its skin and return to plastic bag, saving all of the dissecting fluid.
- Clean and dry dissecting tray, tools, and work area. Clean out the sink at your lab station.
- Wash hands!

Procedure

I. External Anatomy, Skinning and the Integumentary System

<table>
<thead>
<tr>
<th>Structure</th>
<th>Organ System(s)</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinna</td>
<td>External nares (nostrils)</td>
<td>Vibrissa</td>
</tr>
<tr>
<td>Incisors</td>
<td>Papillae</td>
<td>Tail</td>
</tr>
<tr>
<td>Genitalia</td>
<td>Anus</td>
<td>Fur</td>
</tr>
<tr>
<td>Epidermis</td>
<td>Dermis</td>
<td>Abdominal Cavity</td>
</tr>
<tr>
<td>Thoracic Cavity</td>
<td>Pelvic Cavity</td>
<td>Cranial Cavity</td>
</tr>
</tbody>
</table>

A. Identify the above structures on your rat. Draw a ventral view of your rat and label as many of above structures as you can. In addition, label the following anatomical directions: inferior and superior.

B. Once your drawing is complete, skin your rat using the instructions given in class. Work slowly and carefully. Your goal is to remove the skin all in one piece (this is difficult but doable). Save the skin for wrapping your rat to prevent it from drying out.

C. Use your textbook and online resources to research each structure. Construct a chart using the example below. For each structure, identify its organ system(s) and provide a brief description of its function.
<table>
<thead>
<tr>
<th>Structure</th>
<th>Organ System(s)</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td>Digestive</td>
<td>Involved in digestive functions such as producing bile to help digest fat. Also involved in metabolic functions including storage and release of glucose.</td>
</tr>
</tbody>
</table>

D. Answer the following analysis questions in complete sentences.
1. Choose any two external structures and explain how the structure’s function is related to its organ system’s function.
2. Many organ systems have multiple functions. Identify two functions of the integumentary system and briefly explain how the epidermis and dermis contribute to those functions.
3. Compare and contrast both structure and function of rat fur and human hair.
4. Use appropriate anatomical terminology to describe the anatomical relationship between the right pinna and the left papillae.

II. Abdominal Cavity – Digestive, Lymphatic and Endocrine Systems

Assigned structures:

<table>
<thead>
<tr>
<th>Liver</th>
<th>Stomach</th>
<th>Esophagus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreas</td>
<td>Spleen</td>
<td>Small Intestine</td>
</tr>
<tr>
<td>Caecum</td>
<td></td>
<td>Large intestine</td>
</tr>
</tbody>
</table>

A. Identify the above structures on your rat. Draw a ventral view of the rat and label as many of the above structures as you can. In addition, label the anatomical directions: lateral and medial.

B. Use your textbook and online resources to research each of the structures. For each structure, identify its organ system and provide a brief description of its function. Follow the example chart in Part I.

C. Remove each individual organ and set it on a piece of paper for your instructor to check off.

D. Answer the following analysis questions in complete sentences.
1. Describe two functions of the digestive system and briefly explain how any one of the assigned structures contributes to one function.
2. Describe two functions of the lymphatic system and briefly explain how any one of the assigned structures contributes to one function.
3. One of the assigned structures is part of two different systems. What is the structure and how does it contribute to the function of each system?
4. Compare and contrast both structure and function of the rat caecum and the human appendix.
5. Use appropriate anatomical terminology to describe the anatomical relationship between the liver and the pancreas.

III. Pelvic Cavity – Reproductive, Endocrine and Urinary Systems

Assigned Structures:

<table>
<thead>
<tr>
<th>Kidney</th>
<th>Urinary bladder</th>
<th>Ureter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testes</td>
<td>Scrotum</td>
<td>Penis</td>
</tr>
<tr>
<td>Prostate gland</td>
<td>Vas deferens</td>
<td></td>
</tr>
<tr>
<td>Female:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovary</td>
<td>Vagina</td>
<td>Uterus (Uterine horns in rat)</td>
</tr>
</tbody>
</table>

A. Identify the gender and the above structures on your rat. Draw a ventral view of the rat and label as many of the above structures as you can. In addition label the following anatomical directions: proximal and distal.

B. Find a rat of the opposite gender to observe for comparison.

C. Use your textbook and online resources to research each of the structures. For each structure, identify its organ system and provide a brief description of its function. Follow the example chart in Part I.

D. Remove each individual organ and set it on a piece of paper for your instructor to check off.

E. Answer the following analysis questions in complete sentences.
1. Describe two functions of the reproductive system and briefly explain how any one of the assigned structures contributes to one function.
2. Describe two functions of the urinary system and briefly explain how any one of the assigned structures contributes to one function.
3. Identify the structure that is part of both endocrine and reproductive systems. What is the structure’s function in each system and what is the relationship between those functions?
4. Compare and contrast both structure and function of the male and female reproductive system.
5. Use appropriate anatomical terminology to describe the anatomical relationship between the kidney and the urinary bladder.

IV. Neck Region and Thoracic Cavity – Respiratory, Cardiovascular, Digestive and Lymphatic Systems

**Assigned structures:**

<table>
<thead>
<tr>
<th>Lungs</th>
<th>Heart</th>
<th>Trachea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thymus</td>
<td>Diaphragm</td>
<td>Inferior vena cava</td>
</tr>
<tr>
<td>Aortic arch</td>
<td>Salivary Gland(s)</td>
<td>Esophagus</td>
</tr>
</tbody>
</table>

A. Identify the above structures on your rat. *Draw a ventral view of the rat and label as many of the above structures as you can.* Note that some of these structures are within the thoracic cavity (ie. inside the rib cage) and some are in the neck region (ie. outside the rib cage).

B. Use your textbook and online resources to research each of the structures. For each structure, identify its organ system and provide a brief description of its function. Follow the example chart in Part I.

C. Remove the heart and lungs for your instructor to check off.

D. Answer the following analysis questions in complete sentences.

1. Describe two functions of the cardiovascular system and briefly explain how any one of the assigned structures contributes to one function.

2. Describe two functions of the respiratory system and briefly explain how any one of the assigned structures contributes to one function.

3. Discuss the relationship between the cardiovascular and respiratory systems.

4. Discuss the relationship between the cardiovascular and lymphatic systems.

5. Use appropriate anatomical terminology to describe the anatomical relationship between the trachea and the esophagus.

V. Head Region and Cranial Cavity – Nervous, Endocrine, Digestive and Respiratory Systems

**Assigned Structures:**

<table>
<thead>
<tr>
<th>cerebrum</th>
<th>cerebellum</th>
<th>brain stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>spinal cord</td>
<td>pituitary gland</td>
<td>hypothalmus</td>
</tr>
<tr>
<td>tongue</td>
<td>incisors/molars</td>
<td>Esophagus</td>
</tr>
<tr>
<td>trachea</td>
<td>nasal cavities</td>
<td></td>
</tr>
</tbody>
</table>

A. Your teacher will use a special tool to remove the rat’s head. You will use a specialized tool to hemi-section the skull, allowing a mid-sagittal view of the brain.

B. Identify the above structures on your rat. *Draw a mid-sagittal section of the head and label as many of the above structures as you can identify.*

C. Use your textbook and online resources to research each of the structures. For each structure, identify its organ system and provide a brief description of its function. Follow the example chart in Part I.

D. Answer the following analysis questions in complete sentences.

1. Describe two functions of the nervous system and briefly explain how any one of the assigned structures contributes to one function.

2. Describe two functions of the endocrine system and briefly explain how any one of the assigned structures contributes to one function.

3. Discuss the relationship between the nervous and endocrine systems.

4. Compare and contrast the structure and function of the rat brain and the human brain.

5. Use appropriate anatomical terminology to describe the anatomical relationship between the cerebrum and the brain stem.