Background Information:
The endocrine system functions to maintain homeostasis within many of the long-term, ongoing processes that occur in the body. Some examples of these processes include metabolism, temperature, ion and fluid balance and development. To maintain homeostasis within these processes, chemical messengers are deployed into the circulation. These messengers, known as hormones, bind to receptors in or on receptive cells to regulate their behavior.

Interestingly, hormones regulate the behavior of many different types of cells, including those cells that secrete hormones. In this way, hormones sort of regulate their own production and/or activity through ‘feedback loops’ that are sometimes simple, and sometimes more complex and indirect.

The purpose of this lab is to provide you with an overview of the endocrine system. In addition, the activity of specific hormones will be addressed in a video and in a group activity.

Activity A
1.) Listen to the laboratory instructors as they review and introduce some topics relating to hormonal signaling. Try to answer each of the following questions either while they’re presenting information, or while watching the video that will be viewed in class. If you are unable to obtain the answers to these questions regarding hormone messages in the human body, please ask your instructors after watching the video.

   a.) Where are our hormones produced?

   b.) What is a gland?

   c.) What structure is the link between the nervous system and the endocrine system?

   d.) What gland in the brain is a major organizing center of hormone release?

   e.) What is the physiological response over time as a result of an over-active thyroid gland? An underactive thyroid gland?

   f.) What 2 hormones are produced by the adrenal glands? What causes the release of each? Which is released more rapidly? What is the duration of action of each of these hormones? How does their activity eventually subside?

   g.) Explain how each of the hormones above plays a physiological role in ‘crisis’ situations.
h.) What are the physiologic effects of epinephrine on the following:
   1. blood flow
   2. muscle
   3. fat
   4. gut
   5. kidneys
   6. eyes
   7. skin

**Activity B** (obtained from the American Physiology Society teaching archive and modified from an activity entitled ‘Laboratory Exercise Using ‘Virtual Rats’ to Teach Endocrine Physiology” by Odenweller, CM, et al., Advances in Physiology Education 273:S24-40, 1997.)

1.) In this activity, you will be working in small groups to evaluate some ‘autopsy information’ obtained on ‘virtual rats’.
2.) Using your textbook and what you’ve learned in class about the regulation of hormones, hormone activity, and how hormone levels might affect the size of a gland, complete the table below. Put a ‘+’ in a cell if you would expect an increase in the size of a gland or in body weight (bottom row); put a ‘-’ in the cell if you would expect to see a decrease in the size of the gland or in body weight if an animal were treated daily with the hormones noted at the top of the table. Leave a cell in the table empty if you do not expect to see a change in a gland’s size.

<table>
<thead>
<tr>
<th></th>
<th>TRH</th>
<th>TSH</th>
<th>ACTH</th>
<th>Cortisol</th>
<th>LH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pituitary Gland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Thyroid Gland</td>
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<tr>
<td>Adrenal glands</td>
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<tr>
<td>Testes</td>
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<td></td>
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<tr>
<td>Prostate gland</td>
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<td></td>
</tr>
<tr>
<td>Body weight</td>
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</table>

3.) Assume the following scenario to produce the ‘virtual rats’ whose ‘autopsy data’ you will analyze:

   Male rats were either left untreated (control) or were treated daily for two weeks by intravenous injection with one of five hormones. All rats were otherwise treated identically (food, water, etc.). At the end of the two week treatment, all rats were euthanized and subjected to autopsy. The sizes of various endocrine glands was measured and recorded. Overall body weight at the time of euthanasia was also recorded. Unfortunately, due to a miscommunication, all of the rats except the control rat were euthanized together in the same chamber. In other
words, at the time of euthanasia, there was no way to determine which of the five experimental rats was treated with which of the five hormones!

4.) Use the completed table and the autopsy data provided below for each of the ‘virtual rats’ in this experiment to help you determine which of the rats was treated with which of the five hormones (TRH, TSH, ACTH, Cortisol or LH). Except for the control, each rat was treated with only one hormone. Use the values obtained for the control rat as a comparison. To be considered significant, any change observed between the control rat and the experimental rat should be >20% or more. If a change is less than 20%, it is attributed to normal biological differences between individuals or in errors in measurement due to calibration limitations of the measuring equipment.

<table>
<thead>
<tr>
<th>Pituitary</th>
<th>Thyroid</th>
<th>Thymus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>Seminal vesicles</td>
<td>Adrenals on top of kidneys</td>
</tr>
</tbody>
</table>

Graphic representation of organs studied in the autopsy.

Control

Pituitary: 12.9 mg
Thyroid: 250 mg
Thymus: 475 mg
Adrenals: 40 mg
Seminal vesicles: 500 mg
Prostate: 425 mg
Testes: 3200 mg
Body weight: 300 g
Rat 1

Pituitary: 10.1 mg
Thyroid: 245 mg
Thymus: 250 mg
Adrenals: 100 mg
Seminal vesicles: 490 mg
Prostate: 430 mg
Testes: 3000 mg
Body weight: 200 g

Rat 2

Pituitary: 9.8 mg
Thyroid: 250 mg
Thymus: 480 mg
Adrenals: 40 mg
Seminal vesicles: 900 mg
Prostate: 800 mg
Testes: 5700 mg
Body weight: 385 g
Rat 3

Pituitary: 25 mg
Thyroid: 490 mg
Thymus: 462 mg
Adrenals: 39 mg
Seminal vesicles: 480 mg
Prostate: 400 mg
Testes: 3150 mg
Body weight: 160 g

Rat 4

Pituitary: 9.8 mg
Thyroid: 245 mg
Thymus: 150 mg
Adrenals: 30 mg
Seminal vesicles: 475 mg
Prostate: 410 mg
Testes: 3200 mg
Body weight: 150 g
Rat 1 was most likely treated with:

Rat 2 was most likely treated with: __________________________

Rat 3 was most likely treated with: __________________________

Rat 4 was most likely treated with: __________________________

Rat 5 was most likely treated with: __________________________

Rat 5

Pituitary: 8 mg
Thyroid: 500 mg
Thymus: 455 mg
Adrenals: 37 mg
Seminal vesicles: 480 mg
Prostate: 405 mg
Testes: 2790 mg
Body weight: 152 g