**Instructional Suggestions**

1. You might consider the live fish part of this lab as a class demonstration to save expenses and materials needed.
2. HumulinR administered in 200 units will suffice to induce insulin shock within about 5 minutes.
3. Consult with your local pharmacist to purchase insulin and insulin syringes. Store the HumulinR in the refrigerator – do not freeze.
4. The recovery from insulin shock when the fish is placed into a 10% solution of glucose is usually within 5 minutes.
5. The recovery from insulin shock works faster if the fish selected is very small (total length about 1-1.5 inches). The species of fish selected does not seem significant so try a fish species that is readily available. It does not work well to use the same fish for a second experiment for the next section of class. The fish usually survive the experiment and a student is almost always willing to take the fish home after the class is over.
6. It probably works to use the same beakers of insulin and glucose solution for other sections of class the same day; however, use a different fish. Be sure to rinse the fish net between fish transfers from one solution to another and the holding container of aquarium water.

**Figure Labels**

**FIG. 36.1**

1. Hypothalamus
2. Pituitary gland
3. Parathyroid glands
4. Testis (male)
5. Pineal gland
6. Thyroid gland
7. Thymus
8. Adrenal gland
9. Pancreas
10. Ovary (female)

**Laboratory Report Answers**

**PART A**

1. Growth hormone, thyroid-stimulating hormone (TSH), adrenocorticotropic hormone (ACTH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin.
2. Antidiuretic hormone (ADH), oxytocin
3. a. antidiuretic hormone
   b. growth hormone
   c. thyroid-stimulating hormone
   d. oxytocin
   e. adrenocorticotropic hormone
   f. prolactin
4. Thyroxine ($T_4$), triiodothyronine ($T_3$)
5. Calcitonin
6. Parathyroid hormone
7. Bones, intestine, kidneys
8. Epinephrine, norepinephrine
9. Increased heart rate, increased blood pressure, rise in blood sugar concentration, increased metabolic rate, increased breathing rate, dilation of airways, decreased activity in the digestive tract (These are seven possible responses for five requested.)
10. Aldosterone
11. Kidneys conserve sodium ions, kidneys increase excretion of potassium ions, kidneys conserve water (reduce urine volume). (These are three possible responses for two requested.)
12. Cortisol
13. Decreases protein synthesis, increased release and use of fatty acids, stimulates liver to produce glucose from noncarbohydrates
14. Insulin, glucagon

**PART B**

(sketches)

**PART C**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Type 1 Diabetes</th>
<th>Type 2 Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset age</td>
<td>Early age or adult</td>
<td>Usually over 40</td>
</tr>
<tr>
<td>Onset of symptoms</td>
<td>Rapid</td>
<td>Slow</td>
</tr>
<tr>
<td>Percentage of diabetics</td>
<td>10-15%</td>
<td>85-90%</td>
</tr>
<tr>
<td>Natural insulin levels</td>
<td>Below normal</td>
<td>Normal or increased</td>
</tr>
<tr>
<td>Beta cells of pancreatic islets</td>
<td>Destroyed</td>
<td>Not Destroyed</td>
</tr>
<tr>
<td>Pancreatic islet cell antibodies</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>Risk factors of having the disease</td>
<td>Heredity</td>
<td>Heredity, obesity, lack of exercise</td>
</tr>
<tr>
<td>Typical treatments</td>
<td>Insulin administration</td>
<td>Avoid foods that stimulate insulin production, weight control, exercise, medications</td>
</tr>
<tr>
<td>Untreated blood sugar levels</td>
<td>Hyperglycemia</td>
<td>Hyperglycemia</td>
</tr>
</tbody>
</table>

**PART D**

1. (experimental results)
2. (experimental results)
   The amount of time until insulin shock occurs varies with the type of insulin used and the size of the fish selected for the experiment. Rapid or irregular swimming, gill cover, and mouth movements usually are noted within about 5-10 minutes.
3. (experimental results)
   Recovery from insulin shock usually occurs within about 5-10 minutes.

**Critical Thinking Application Answers**

The main hormone regulating blood sugar is insulin. A normal person’s insulin level will adjust the blood sugar homeostasis level according to changes in daily diets and exercise levels. A person with type 1 diabetes needs to attempt to have similar daily diets and exercise to correlate with the designated daily insulin administered.