I. **Announcements**  
To make Lab 5 educational, fun & safe for all, please read pp 5-1 thru 5-6 in LM twice before Thursday! Remaining exams & notebooks returned > lecture. Key posted in glass box in Huestis near 120 HUE. Estimate grade? Q?

II. **Blood Chemistry Connections**  
LS ch 11 p 303, ch 17 pp 525-36  
Erythroblastosis fetalis, diabetes, insulin, glucagon

III. **Endocrinology Overview**  
LS ch 17, DC Module 13, SI Fox+  
A. Vignette: Cushing's syndrome LS fig 17-20 p 521-2  
B. Endocrine system DC p 103 fig 13-1, LS fig 17-1, tab 17-1  
C. What’s an endocrine? + classes ~ LS pp 495 - 6  
D. Hypothalamus (Master) – Pituitary (subcontroller)  
   DC pp 104-6 + LS pp 499-506  
E. Posterior pituitary + hormones DC p 108, LS fig 17-4 p 502  
F. Anterior pituitary + hormones DC pp 105-7, LS pp 502-6  
H. Peripheral endocrine organs DC pp 109-13, LS pp 513-36  
   1. Pancreas (insulin – glucagon see-saw!) 2. Thyroid 3. Adrenals

...This Thursday more fun & data about me! Heck yeah!!
Students who succeed are usually those who:

(1) **Attend** class regularly
(2) **Ask** questions
(3) **Come** to office hours & problem-solving sessions
(4) **Study** outside class both alone & in study groups
(5) **Seek** to understand methods & overarching principles/concepts rather than specific answers
(6) **Teach** or tutor others &
(7) **Discuss** concepts informally with fellow students.

Q? What do I need on the final, if I want to get…?

A? You can actually calculate given assumptions…

e.g., 62 for Exam I & desire ≥ B- (assume ≥ 80)

Assume 100% for lecture (20% of grade)
+ lab attendance & participation (20% of grade!)

X = [80 - ((0.3 x 62) + (0.2 x 100) + (0.2 x 100))]/0.3

X = [80 - [(18.6) + (20) + (20)]]/0.3

X = [21.4]/0.3 = 71.3

…Fortunately, the lab buffers the grade!
Erythroblastosis Fetalis?

e.g., Rh- mom Rh+ baby

Erythroblastosis Fetalis or Hemolytic Disease of the Unborn/Newborn

Throw Blanket Over This Step!
Inject Mom with RhoGam < 48-72 hr > each Rh+ Pregnancy

The Blanket is RhoGam → Masks the Mom’s Immune System!
1994 Diabetes Prevalence in the US by State

Key:
- Yellow: <4.5%
- Light Blue: 4.5%-5.9%
- Light Green: 6.0%-7.4%
- Purple: 7.5%-8.9%
- Brown: ≥9%

Source: Centers for Disease Control, Division of Diabetes Translation, [http://www.cdc.gov/diabetes/statistics](http://www.cdc.gov/diabetes/statistics), S&W 2014 fig 4-15 p139A.
2010 Diabetes Prevalence in the US by State

Diabetic & Normal Response to Glucose Load

Blood glucose level (mg/100 ml)

Hours

Guyton & Hall 2000
Glucose: Sugar in Blood

Normal: 70-99
Pre-Diabetes: 100-125
Diabetes: ≥ 126 mg/dL
FIG. 10-4. Amino acid sequence of a mammalian proinsulin molecule. Note how the insulin molecule can be formed by cleaving this polypeptide chain at two locations to liberate the C peptide.
Times of Plenty!!

NB: Diabetics have problems either here or here.

Blood

Glucose

Islets

A cells

Glucagon

B cells

Insulin

Cellular uptake and utilization of glucose

Fox 1987
Times of Need!

Blood

Glucose

Glucose

Cellular uptake of glucose

Glycogenolysis

A cells

B cells

Islets

Glucagon

Insulin

Mobilize!!

Fox 1987
<table>
<thead>
<tr>
<th></th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of cases</td>
<td>5–10%</td>
<td>90–95%</td>
</tr>
<tr>
<td>Age of onset</td>
<td>&lt;30 years</td>
<td>&gt;40 years&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Associated characteristics</td>
<td>Autoimmune diseases, viral infections,</td>
<td>Obesity, aging, inherited factors</td>
</tr>
<tr>
<td></td>
<td>inherited factors</td>
<td></td>
</tr>
<tr>
<td>Primary problems</td>
<td>Destruction of pancreatic beta cells;</td>
<td>Insulin resistance, insulin deficiency</td>
</tr>
<tr>
<td></td>
<td>insulin deficiency</td>
<td>(relative to needs)</td>
</tr>
<tr>
<td>Insulin secretion</td>
<td>Little or none</td>
<td>Varies; may be normal, increased, or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decreased</td>
</tr>
<tr>
<td>Requires insulin</td>
<td>Always</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Older names</td>
<td>Juvenile-onset diabetes</td>
<td>Adult-onset diabetes</td>
</tr>
<tr>
<td></td>
<td>Insulin-dependent diabetes</td>
<td>Noninsulin-dependent diabetes</td>
</tr>
<tr>
<td></td>
<td>mellitus (IDDM)</td>
<td>diabetes mellitus (NIDDM)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Some cases occur in childhood but more commonly in adulthood.
# Table 4–9

**Warning Signs of Diabetes**

These signs appear reliably in type 1 diabetes and, often, in the later stages of type 2 diabetes.

- Excessive urination and thirst
- Glucose in the urine
- Weight loss with nausea, easy tiring, weakness, or irritability
- Cravings for food, especially for sweets
- Frequent infections of the skin, gums, vagina, or urinary tract
- Vision disturbances; blurred vision
- Pain in the legs, feet, or fingers
- Slow healing of cuts and bruises
- Itching
- Drowsiness
- Abnormally high glucose in the blood
Diabetics must constantly juggle diet, exercise & medication to control blood glucose!
Like others, diabetics benefit from whole grains, vegetables, fruits, legumes & non-/low-fat milk products!
Exercise is a must based on its insulin-like effect!
Cushing’s Syndrome = Hypersecretion of Cortisol: Hypothalamic (CRH), Pituitary (ACTH), or Adrenal (Cortisol)
ANP = Atrial Natriuretic Polypeptide
Hormone/Endocrine Classifications

Exogenous

Endogenous

[Diagram showing biochemical processes]
Hypothalamus & Pituitary: Intimate Relationship
Hypothalamus
< 1% of Brain Mass
Hormone Master Controller
+100s of Functions!

Good Things Come in Small Packages!

Kreiger & Hughes 1980
Hypothalamus-Anterior Pituitary Vascular Connection!

Vascular Connection!!

- Neurosecretory neuron
- Systemic arterial inflow
- Hypothalamic-hypophyseal portal system
- Anterior pituitary
- Posterior pituitary
- Systemic venous outflow

- = Hypophysiotropic hormones
- = Anterior pituitary hormone

LS 2007
Pituitary Nourishing or Growth Hormones

Hypothalamus

Neurosecretory neuron

Systemic arterial inflow

Hypothalamic-hypophyseal portal system

RH + or RIH -

Releasing or Release-Inhibiting Hormones

Systemic venous outflow

- Hypophysiotropic hormones
- Anterior pituitary hormone

Hypophysis = Pituitary

LS 2007
fig 17-10
Progression & Development of Acromegaly

Age 13

Age 21

Age 35
Growth Hormone = Somatotrophic Hormone
Body Builder’s Dream?
GH/STH Effects: Insulin Resistance/Type II Diabetes?

- ↑ Amino Acid uptake & Protein synthesis
- ↑ Lipolysis & Fatty Acid mobilization
- ↓ Glucose uptake
  (skeletal muscle & adipocytes)
- ↑ Glucose production
  (liver glycogenolysis)
- ↑ Insulin secretion
Increase GH naturally with exercise & sleep!!

**Graph: Growth hormone (ng/ml plasma) vs. Time of day**

- Peaks indicate periods of strenuous exercise.
- Sleep phase shows a decline in growth hormone levels.

ng/ml = nanograms per milliliter
Endocrine Pancreas: Insulin (I) & Glucagon (G)
See-Saw Hormones in Regulating Blood Glucose

- Duct cells secrete aqueous NaHCO₃ solution
- Acinar cells secrete digestive enzymes
- Exocrine portion of pancreas (Acinar and duct cells)
- Endocrine portion of pancreas (Islets of Langerhans)
- Bile duct from liver
- Stomach
- Duodenum

Hormones (insulin, glucagon)

Blood

The glandular portions of the pancreas are grossly exaggerated.
FIGURE 13-12
Adrenal Gland  The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.
Epinephrine 80%
Norepinephrine 20%