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 HUE down hall from lab. Estimate grade? Q?

II. **Blood Typing** LS ch 11 + 17, DC Module 5, Q?

III. **Blood Glucose, Insulin Diabetes Connections** DC Module 13+…

IV. **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
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 Exam II, if I want to get…?

A? You can actually calculate given assumptions…

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

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

<table>
<thead>
<tr>
<th>Hope for?</th>
<th>Exam I</th>
<th>Lecture</th>
<th>Lab</th>
</tr>
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<tbody>
<tr>
<td>X = [80 - ((0.3 \times 62) + (0.2 \times 100) + (0.2 \times 100))]/0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X = [80 - [(18.6) + (20) + (20)]]/0.3</td>
<td></td>
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<tr>
<td>Need this on Exam II for B- for course!</td>
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…Fortunately, the lab buffers the grade!
Next time, like last Thursday, we’ll cover the blood chemistry lab, to ensure for adequate lab prep time. For now, we’ll cover more on blood typing Abo, Rh+ vs Rh- & glucose!
A Antigens
(Agglutinogens)
B Antigens
(Agglutinogens)
A & B Antigens
(Agglutinogens)
No Antigens
(Agglutinogens)
A Antibodies
(Agglutinins)
Clumping with anti-A serum
No Clumping with anti-A serum
Blood Type Distribution within the United States

- **Type O+**: 38%
- **Type A+**: 34%
- **Type B+**: 9%
- **Type A-**: 6%
- **Type B-**: 2%
- **Type AB+**: 3%
- **Type AB-**: 1%
- **Type O-**: 7%

**NB**: O+ & A+ make up > 2/3, + > -
Erythroblastosis Fetalis?

eg, $\text{Rh}^-$ mom $\text{Rh}^+$ baby

Erythroblastosis Fetalis or Hemolytic Disease of the Unborn/Newborn

(a) First pregnancy

Rh- mother

Placenta

First Rh+ fetus

Rh+ antigens

(b) Second pregnancy

Second Rh+ fetus

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!
Diabetic & Normal Response to Glucose Load

Blood glucose level (mg/100 ml)

Hours

- Diabetes
- Normal

Guyton & Hall 2000
**Proinsulin with C-Connecting Peptide**

**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!!

Diabetics have problems either here or here.

NB: Diabetics have problems either here or here.

Cellular uptake and utilization of glucose

Fox 1987
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<th>Type 2</th>
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<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, inherited factors</td>
<td>Obesity, aging, inherited factors</td>
</tr>
<tr>
<td>Primary problems</td>
<td>Destruction of pancreatic beta cells; insulin deficiency</td>
<td>Insulin resistance, insulin deficiency (relative to needs)</td>
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<tr>
<td>Insulin secretion</td>
<td>Little or none</td>
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<td>Adult-onset diabetes</td>
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## 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
Diabetic & Normal Response to Glucose Load

Ingest Glucola or eat meal

Guyton & Hall 2000
Proinsulin with C-Connecting Peptide

**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.
Endocrine Pancreas: Insulin (I) & Glucagon (G) See-Saw Hormones in Regulating Blood Glucose
Times of Plenty!!

NB: Diabetics have problems either here or here.

Fox 1987

https://www.youtube.com/watch?v=8dgoeYPoE-0
1994 Diabetes Prevalence in the US by State

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 p139B.
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<sup>a</sup> As of the last update to this table.
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- 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

https://www.ted.com/talks/emma_bryce_how_do_your_hormones_work
https://www.youtube.com/watch?v=IRJE8c3ghRE
https://www.hopkinsallchildrens.org/Patients-Families/Health-Library/HealthDocNew/Movie-Endocrine-System
Hormone/Endocrine Classifications?

Exogenous

Endogenous

Amino Acid/PP/Protein

Thyroid

Steroid
Hypothalamus & Pituitary: Intimate Relationship
Hypothalamus
< 1% of Brain Mass
Hormone Master Controller
+100s of Functions!

Good Things Come in Small Packages!

Kreiger & Hughes 1980
Nervous Connection!!

- Neurosecretory neurons
- Hypothalamic-posterior pituitary stalk
- Anterior pituitary
- Posterior pituitary

Systemic arterial inflow
Systemic venous outflow

• = Vasopressin
• = Oxytocin
Hypothalamus-Anterior Pituitary Vascular Connection!

**Vascular Connection!!**

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

- = Hypophysiotropic hormones
- = Anterior pituitary hormone

LS 2007
Pituitary Nourishing or Growth Hormones

RH + or RIH -

Releasing or Release-Inhibiting Hormones

Hypophysis = Pituitary
Capillary-Venule-Capillary Intimate Circulation

Krieger & Hughes 1980
Often, more than simply 1 feedback loop!
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

Mismatch!!
Increase GH naturally with exercise & sleep!!

![Graph showing the correlation between growth hormone (GH) levels and time of day, with peak levels during sleep and exercise.](image)

**Growth hormone (ng/ml plasma)**

- **Sleep**
- **Strenuous exercise**

**Time of day**

**ng/ml = nanograms per milliliter**