This review only include the new material for the third test (from the GI lectures to both repro lectures). It will highlight the main topics having in mind the test questions you will see Wednesday. Remember that all tests are cumulative.

**Course Outline**

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<th>Week 1 to week 2</th>
<th>Topic #</th>
<th>Topic lecture</th>
<th>Silverthorn</th>
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<tr>
<td>Topic #1</td>
<td>Introduction (pre-requisite material)</td>
<td>1 - 5 Pre-requisite Material (chapter # 5)</td>
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<td>Topic #2</td>
<td>Membranes (pre-requisite material)</td>
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<td>Topic #3</td>
<td>Homeostasis and Signal Transduction</td>
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<td>Topic #4</td>
<td>Endocrine Communication and the Endocrine System</td>
<td>7 lectures, recitations, office hours, review, exam 1 (chapter # 8)</td>
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<td>Topic #5</td>
<td>Neural Communication and the Sensory System</td>
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<td>Topic #6</td>
<td>Muscle, Muscle Contraction and their Regulation</td>
<td>12 - 13</td>
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**Week 3 to week 4**

| Topic #7         | Basic Physiology of the Cardiovascular System | 14 - 17 lectures, recitations, review, exam 2 (chapter # 7) |              |
| Topic #8         | Basic Physiology of the Respiratory System    | 18                                                               |              |
| Topic #9         | Basic Physiology of the Renal System          | 19 - 20                                                           |              |

**REVIEW #1 material from topic #01 – #06**

**EXAM #1 material from topic #01 – #06 (33%)**

- 1 - 13
- 1 - 13

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<th>Week 5 to week 6</th>
<th>Topic #10</th>
<th>Basic Physiology of the Gastrointestinal System</th>
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<td>Topic #11</td>
<td>Food Intake, Metabolism, Energy Balance and Exercise</td>
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<td>Topic #12</td>
<td>From Sexual Differentiation to Adult Reproduction</td>
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**REVIEW #2 material from topic #01 – #09**

**EXAM #2 material from topic #01 – #09 (33%)**

- 1 - 20
- 1 - 20

| Topic #13        | Basic Physiology of the Respiratory System | 1 - 20                                                          |              |

**REVIEW #3 material from topic #01 – #12**

**EXAM #3 material from topic #01 – #12 (33%)**

- 1 - 26
- 1 - 26

(all tests are cumulative)
Physiology of Metabolism, Food Intake and Energy Balance

Physiology of Metabolism, Food Intake and Energy Balance
Physiology of Metabolism, Food Intake and Energy Balance

**Absortive State**

**Nutrient Metabolism in the Absorptive Period**

1. Energy is provided primarily by absorbed carbohydrate in a typical meal.
2. There is no uptake of glucose by the liver.
3. Some carbohydrate is stored as glycogen in liver and muscle, but most carbohydrate and fat in excess of that used for energy are stored mainly as fat in adipose tissue.
4. There is some synthesis of body proteins, but some of the amino acids in dietary protein are used for energy or converted to fat.
Nutrient Metabolism in Post-Absorptive Period

1. Glycogen, fat, and protein syntheses are curtailed, and net breakdown occurs.
2. Glucose is formed in the liver both from the glycogen stored there and by gluconeogenesis from blood-borne lactate, pyruvate, glyceral, and amino acids. The kidneys also perform gluconeogenesis during a prolonged fast.
3. The glucose produced in the liver (and kidneys) is released into the blood, but its utilization for energy is greatly reduced in muscle and other nonessential tissues.
4. Lipolysis releases adipose tissue fatty acids into the blood, and the oxidation of these fatty acids by most cells of the body provides most of the body's energy supply.
5. The brain continues to use glucose but also starts using ketones as they build up in the blood.
The PVN is a main central integrator involved in neuroendocrine control of food intake.
Physiology of Metabolism, Food Intake and Energy Balance

Inputs to a Central Integrator

The PVN is a main central integrator involved in neuroendocrine control of food intake

Physiology of Metabolism, Food Intake and Energy Balance

Obesity & anorexia are only the extremes of the central integrators' playfield
Physiology of Metabolism, Food Intake and Energy Balance

Metabolic Dysfunction

- Dysfunction of energy homeostasis and hypertension might arise from exposure of body cells to nutrient excess.
- Nutrient excess may lead to oxidative stress, and to an inflammatory and unfolded protein responses in SER.
- Accumulation of long-chain fatty acyl-CoA usually oxidized in mitochondria to ATP.
- Low mitochondrial activity induced by nutrient excess.
- Activation of signaling paths promoting inflammation as, for example, inhibitor NF-κB.
- A similar effect of inflammation on β-cells might explain β-cell exhaustion & DM type 2.
- A similar effect of inflammation on the IRS-PI3K path of endothelial cells decreases the generation of NO, a widespread vasodilator signal.

Basic Physiology of the Reproductive System

- A good example of the importance of gene activation (homeotic genes?) and of transcription factors (proteins).
- Stabilization of the Wolffian ducts
- Male differentiation of the urogenital sinus and external genitalia
Basic Physiology of the Reproductive System

Examples of maturational events of the HPG axis

- GnRH migration from olfactory placode
- Pulsatility intrinsic role of GnRH neuron
- GnRH differentiate AP - gonadotrophs
- Fetal FSH / LH receptor uncoupled to AC
- Early neurogenic link AHA - POA & ovary
- Lack of fetal E2 - Fb contributes to early growth of primordial follicles
- Stimulatory effect of E2 on preovulatory LH surge occurs years after birth
- Prepubertal Prl / GH increase the ability of FSH to induce LH receptors
- Stimulatory VIP (E2,P4), adrenergic nerves & Epi acting by β-receptors (P4) are fully established during the prepubertal period

Basic Physiology of the Reproductive System

Hormonal Control of Ovarian Function

Oogenesis

Menstrual Cycle

Endometrial Growth

Ovarian Events

Follicular Phase

Luteal Phase

Ovulation occurs

Corpus luteum functions

Corpus luteum degenerates

Multiple follicles develop

Dominant follicle selected

Large mature COs

Follicular Ovulation

Corpus luteum

Estrogen Secretion

LH Surge

Menstruation

Corpus luteum

Estrogen

Menstrual cycle

Hormonal control of ovarian function.
Basic Physiology of the Reproductive System

Theca cells
Granulosa cells
Primordial follicles
Corpus luteum
Oocyte
Graafian follicle
Graafian Follicle Development
Theca interna
Antrum

LH (milli-international units/ml)
FSH (milli-international units/ml)
Progesterone (nanograms/ml)
Estrogen (nanograms/ml)

Day of cycle
Menstruation
1/2

The Ovarian Cycle
Basic Physiology of the Reproductive System

- removal of P4 negative Fb on FSH / LH (by luteolysis) as starting point of a cyclic race to fun or problems
- increase tonic FSH / LH release (amplitud, frequency), as initial response of the neuroendocrine system
- increase E2 intraovarian & hypothalamic effects, as a little engine going beserk to fulfill a "sponge" goal
- estradiol triggers the pre-ovulatory surge of LH
- GnRH neuron "practically" lacks E2 receptors, main cause we have worried about the neurotransmitter mess (+,- input array)
- synapsis among GnRH neurons and the concepts of network and subnetworks
- coexistence of GnRH and galanine in a subnetwork
- NPY and the role of E2 as an example of GnRH input array
- 8END & GnRH deshinibition as a mechanism for LH surge
Basic Physiology of the Reproductive System

The GnRH neuron is the link between reproductive-related brain function and the reproductive system.

Reconstructions of populations of GnRH neurons in young and middle-aged rats reveal progressive increases in subgroups expressing Fos protein on proestrus and age-related deficits. Rubin BS, Mitchel S, Lee CE and King JC. Department of Anatomy and Cell Biology, Tufts University School of Medicine, Boston, MA 02111.