Ch. 1 – Introduction to Physiology

Ch 1 Objectives:

Part 1. Understand homeostasis & feedback loops
Part 2. Review chemistry of pH (as it applies to physiology)

Announcements:

- Are you something other than pre-nursing (pre-pharmacy, pre-med, pre-vet)?
- Course webpage is NOT on Blackboard! It’s simply online.
- A link to the course textbook can be found on online syllabus.

Homeostasis components:

a) Stimulus: a change in a body function, usually outside of normal range.

b) Sensor (receptor): detects this change. Sends signal to integrating center.

c) Integrating center: where sensory info. is interpreted, compared to a “set point” or normal range for that body function. Responds by sending a command (nervous or endocrine).

d) Effector = muscle or gland that responds to the command.

e) Effect = usually reverses the initial change in body function (if neg. feedback loop).

Feedback Loops:

1. Positive Feedback Loop

   = when change occurs body responds by causing more of that change. (Amplifies the effect)  * rare feedback system in the body!

Ex. A) Positive Feedback Loop = Nursing & Oxytocin release

1. Stimulus = baby suckles on nipple
2. Sensor = touch receptors in nipple
3. Integrating center & 4. effector = Hypothalamus (paraventricular nucleus) releases oxytocin, which stimulates milk letdown in mammary glands
5. Effect = milk is released into milk duct

   \[ \text{As long as baby nurses, oxytocin is released.} \]
   \[ \text{When nursing stops, oxytocin release stops.} \]

Ex. B) Positive Feedback Loop = Birth & Oxytocin release

1. Stimulus = baby’s head presses on cervix
2. Sensor = stretch receptors in cervix
3. Integrating center & 4. effector = Hypothalamus hypothalamic nucleus (paraventricular) release oxytocin, which causes strong uterine contractions.
5. Effect = baby is squeezed further into cervix and out of vagina

   \[ \text{Squeezes baby more against cervix} \]
   \[ \text{Cervix stretch receptors activated more} \]
   \[ \text{More oxytocin released} \]
   \[ \text{This continues until “stimulus” is gone (baby has cleared the cervix - been born)} \]

Part 1. Physiology, homeostasis, and feedback loops.

Physiology = the study of how the body maintains homeostasis.

Homeostasis = how the body keeps vital functions within normal range.

2 Systems that regulate homeostasis:

1. Nervous system
2. Endocrine system

List some important vital signs (which body maintains homeostasis of) that nurses routinely measure on patients in an office visit:

<table>
<thead>
<tr>
<th>Vital Sign</th>
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<tbody>
<tr>
<td>Body temperature</td>
</tr>
<tr>
<td>Blood pressure</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Respiratory rate</td>
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<tr>
<td>Blood glucose</td>
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<tr>
<td>Etc...</td>
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</tbody>
</table>
**Ex. A) Negative Feedback Loop = Body temperature**

**Body Temp Set Point** = 98.6 °F (range 97.6 - 99.6 °F)

- **Stimulus**: body temp above setpoint
- **Sensors**: thermoreceptors in body
- **Integrating Center**: hypothalamus (anterior nucleus)
- **Effectors**: sweat glands, which release sweat to cool body
- **Effect** = decrease body temperature

**Stimulus**: body temp below setpoint

- **Sensors**: thermoreceptors in body
- **Integrating Center**: hypothalamus
- **Effectors**: skeletal muscles (which shiver to make heat)
- **Effect** = increase body temperature

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**Ex. B) Negative Feedback Loop = Regulation of blood glucose.**

1. **Stimulus**: change in blood glucose

- **Depending on blood glucose levels pancreas secretes:**
  1. Stimulus: If blood glucose too high
  - **Sensor, Integrating Center, & Effector**: Pancreas beta cells secrete Insulin – which stimulates body cells to take in glucose.
  - **Effect**: decreased blood glucose

- **VERSUS**
  1. Stimulus: If blood glucose too low
  - **Sensor, Integrating Center, & Effector**: Pancreas alpha cells secrete Glucagon – which tells liver to break glycogen (a storage form of glucose) & release glucose into blood
  - **Effect**: increased blood glucose

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**Ex. C) Negative Feedback Loop = Blood Pressure changes w/ posture**

When you stand up after lying down your blood pressure briefly drops. Medulla responds to correct by negative feedback.

**Supine posture**

1. **Stimulus**: BP too low (Systolic BP below 80 mmHg)
   - **Sensors**: baroreceptors in aortic arch & carotid arteries
   - **Integrating Center**: Medulla oblongata (cardiac & vasomotor centers)
   - **Effectors**: heart (heart rate goes up) smooth muscle of arteries (cause vasoconstriction)
   - **Effect**: increased blood pressure

**VERSUS**

1. **Stimulus**: BP too high (Systolic BP over 160 mmHg)
   - **Sensors**: baroreceptors (pressure receptors) in aortic arch & carotid arteries
   - **Integrating Center**: Medulla oblongata (cardiac & vasomotor centers)
   - **Effectors**: heart (heart rate goes down) smooth muscle of arteries (cause vasodilation)
   - **Effect**: decreased blood pressure
See practice flow diagram on negative feedback regulation of high and low blood pressure (blank and high BP KEY and low BP KEY both found in online syllabus)

**Review**

- Physiology
- Homeostasis
  - Dynamic constancy of internal environment despite external changes
- Feedback Loops
  - Positive Feedback (breast feeding & milk let-down, and childbirth)
  - Negative Feedback (body temp, blood glucose, blood pressure)

See syllabus for practice flow diagrams:

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**Part 2: Basics of Physiological Chemistry**

1. Understand physiology of pH

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**Blood pH range = 7.35 – 7.45**

**ACIDOSIS** = blood pH < 7.35.

**ALKALOSIS** = blood pH > 7.45.

**Blood pH outside normal range interferes with:**

> hemoglobin’s oxygen carrying capacity
> Functions of enzymes
> Chemical reactions involved in homeostasis

**Organ systems that regulate blood pH:**

1. Lungs fastest to regulate blood pH. (Pg 10 of Wiki text)
2. Kidneys
3. Liver

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**Determining acidity or alkalinity w/pH scale**

Ex: How much more acidic is urine (pH 6) than baking soda (pH 9)?

Ex: How much more acidic is stomach acid (pH 1) than distilled water (pH 7)?

Ex: How much more acidic is stomach acid (pH 1) than soap (pH 12)?
Review

- pH Scale
  - Acids
  - Bases
- Organ systems that regulate blood pH
- Acidosis & alkalosis