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.

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: Pg 8 Wiki book notes

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>Body temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Respiratory rate</td>
</tr>
<tr>
<td>Blood glucose</td>
</tr>
<tr>
<td>Etc...</td>
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</tbody>
</table>
**Homeostasis components:**

Pg 4 Wiki book notes

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).

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

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

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**Feedback Loops:** Pg 5 Wiki book notes

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

2. **Negative Feedback Loop (most common!)
   = when change occurs body responds by **reversal** of the change.
   (Reverses the effect) * Most common feedback system!
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

> As long as baby nurses, oxytocin is released.
> 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

> Squeezes baby more against cervix
> Cervix stretch receptors activated more
> More oxytocin released
> This continues until “stimulus” is gone (baby has cleared the cervix - been born)
Ex. A) Negative Feedback Loop = Body temperature

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

**Stimulus** = \( \uparrow \) body temp above setpoint

Sensors = thermoreceptors in body

Integrating center (anterior nucleus) = Hypothalamus (anterior nucleus)

Effectors = sweat glands, which release sweat to cool body

Effect = \( \downarrow \) body temperature

**Stimulus** = \( \downarrow \) body temp:

Sensors = thermoreceptors in body

Integrating center (anterior nucleus) = Hypothalamus

Effectors = skeletal muscles (which shiver to make heat)

Effect = \( \uparrow \) body temperature

See practice flow diagram on **negative feedback regulation of body temperature**

(blank and **KEY** both found in online syllabus)
Ex. B) Negative Feedback Loop = Regulation of blood glucose.

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

   *Depending on blood glucose levels pancreas secrete:

   - **Blood glucose goes back up**
   - **Blood glucose goes back down**

   **VERSUS**

1. **Stimulus**: If blood glucose too high

   2. Sensor, 3. integrating center, & 4. effector = Pancreas beta cells secrete **Insulin** – which stimulates body cells to take in glucose.

   5. **Effect** = decreased blood glucose

   **VERSUS**

1. **Stimulus**: If blood glucose too low

   2. Sensor, 3. integrating center, & 4. effector = Pancreas alpha cells secrete **Glucagon** – which tells liver to break glycogen (a storage form of glucose) & release glucose into blood

   5. **Effect** = increased blood glucose

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*See practice flow diagram on negative feedback regulation of blood glucose (blank and **KEY** both found in online syllabus)*
Ex. C) Negative Feedback Loop = Blood Pressure change w/ Posture

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

VERSUS

1. **Stimulus** = BP too low  \(\downarrow\) (Systolic BP below 80 mmHg)
2. **Sensors** = baroreceptors in aortic arch & carotid arteries
3. **Integrating center** = Medulla oblongata (cardiac & vasomotor centers)
4. **Effectors** =
   - heart (heart rate goes up)
   - smooth muscle of arteries (cause vasoconstriction)
5. **Effect** = increased blood pressure \(\uparrow\)

1. **Stimulus** = BP too high  \(\uparrow\) (Systolic BP over 160 mmHg)
2. **Sensors** = baroreceptors (pressure receptors) in aortic arch & carotid arteries
3. **Integrating center** = Medulla oblongata (cardiac & vasomotor centers)
4. **Effectors** =
   - heart (heart rate goes down)
   - smooth muscle of arteries (cause vasodilation)
5. **Effect** = decreased blood pressure \(\downarrow\)
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:
1. Understand physiology of pH

**pH**

= logarithmic scale of:  
Hydrogen ions (H+)  
Hydroxide ions (OH-)

**Numerical scale 0 – 14**

< 7 = acidic (has more H+ ions)  
7 = neutral  
> 7 = alkaline (has fewer H+ ions and more OH- ions)

**Importance of pH:**

- shapes/functions of molecules  
- Enzyme activity  
- Most chemical reactions in body  
- Ability of molecules to dissolve in water
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)?

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
Review

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