Biology 235

Human Physiology

Fall Semester, 2009

Introductions

Questions

Physiology Roots

Physiology Foundations

Integrated Physiology

Physiology – It's Roots

- One of the oldest branches of science
- Starting around 420 B.C.
  - Hippocrates –
    - moved it from theology and religion into its own field
      - Argued that disease was not a handout from angry Gods, but rather from poor diet, environment, and habits
    - Called the "father of medicine"
    - Founded Hippocratic School of Medicine
    - His sons, and son-in-law studied under him
      - Polybus (son-in-law) and Thessalus founded the Dogmatic School of Medicine

Physiology – It's Roots

- Next big influence was Galen
  - 129-200 (ish) A.D.
  - Became father of modern medicine, studied anatomy* extensively
    - His drawings of mammalian structure were used until 1500's!
    - Developed the concept that the brain controls the muscles and that there where cranial and peripheral nervous systems

**of monkeys – human dissection not allowed*

Physiology – It's Roots

- Not much happened until…
  - Vesalius (1514 - 1564) was an anatomist and physician
    - Did extensive human dissection
  - Published the premier book on human anatomy *De humani corporis fabrica*
  - Corrected the error of Galens circulation pattern
    - However held onto the misconception that arteries and veins carry different types of blood
  - Fame led him to become the physician to the Holy Roman Emperor Charles V

Physiology – It's Roots

- William Harvey (1578 – 1657)
  - Correctly figured out systemic circulation and the properties of blood and its pumping
    - Fixed a century old belief that blood only circulated continuously in the lungs
  - Figured out the function of venous valves
  - First to use quantitative analysis in study of human function
    - Measured how much blood the heart pumped in a day (540 pounds) which then made Galen look silly. . . the liver would have to manufacture 540 pounds of blood each day!
  - Was the personal physician to James I & Charles I

Physiology – It's Roots

- Claude Bernard (1813 – 1878)
  - The first to establish scientific methodology in medicine
  - Introduced experimental medicine and specifically "blind studies" to ensure objectivity
  - Introduced "Milieu interieur" which was the initial concept of homeostasis
    - *"The constancy of the internal environment is the condition for a free and independent life"*
    - Furthered in the next century by William Bradford Canon

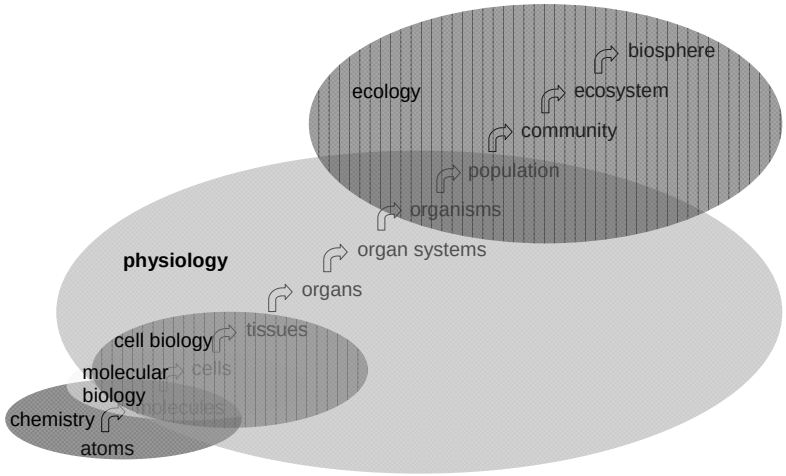
Physiology – It's Roots

- Walter Bradford Cannon (1871 – 1945)
  - Chaired the Department of Physiology at Harvard Medical School
  - Coined the term "fight or flight"
  - Did work with x-rays and different metals to improve x-ray quality of bowels (today's barium meal is a direct result)
  - Given credit for concept of homeostasis, published it in 1932

Physiology Foundations

- Organization
- Homeostasis & Controls
- Biological Energy
- Structure Function Relationships
- Communication

Organizational Hierarchy in Biology

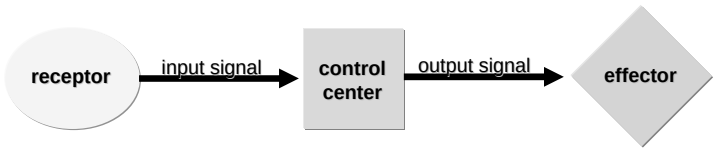


Homeostasis

- The maintenance of physiological parameters within the body/cell
  - "homeo" = similar or like
  - "stasis" = condition or state
- Provides a teleological answer to questions
- Acts in a mechanistic way
  - Components
  - Process
  - Types

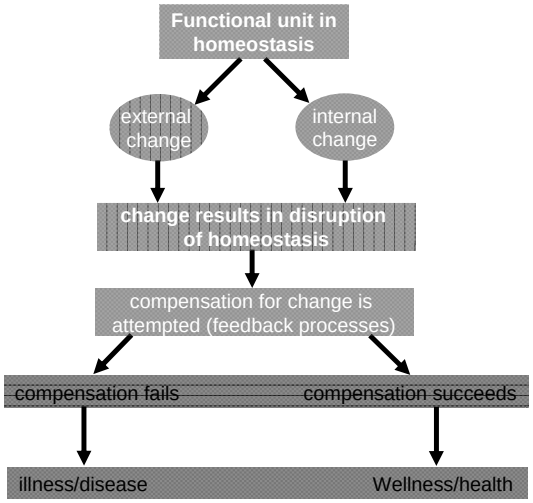
Homeostasis

- **Components**
  - **Receptor**
    - Monitors the controlled condition
    - Creates input signal
  - **Control center**
    - Processes input signal
    - Makes decision
    - Creates output signal
  - **Effector**
    - Returns controlled condition to normal state in one of two ways



Homeostasis

Process:

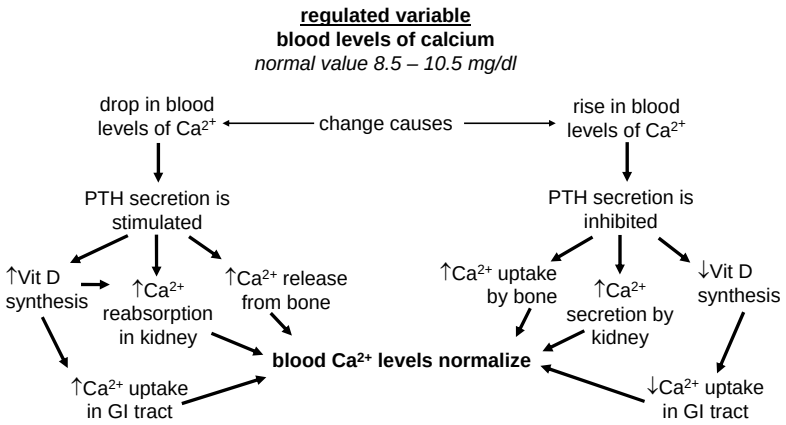


Homeostasis

- Types of homeostasis maintenance pathways
  - Negative Feedback Loop Mechanisms
    - Common
      - Reverse the change in the regulated variable back to normal
    - May be local or long distance
      - Require reflex pathways
  - Positive Feedback Loop Mechanisms
    - Rare
      - Enhances the stressor in a cascading effect until stressor is removed, causing regulated variable to return to normal
  - Feedforward Controls
    - Aid in homeostatic processes by "anticipating" events, rather than waiting for them to happen and then responding

Homeostasis

- Negative Feedback Control Example: blood Ca^{2+} levels



Homeostasis

- Other Negative Feedback Examples?

receptors in plasma membrane

body temperature maintenance

blood glucose levels

ventilation rates

blood pressure regulation

Urine concentration/ dilution

thyroid hormone levels

pH controls

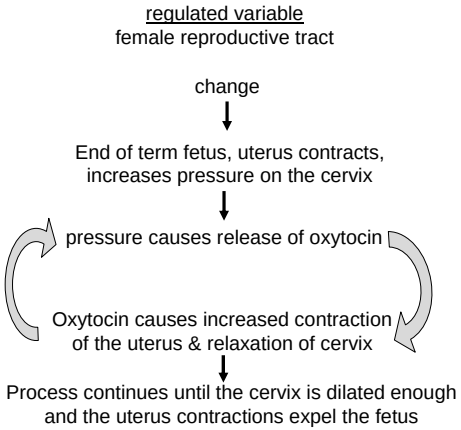
CO_2 levels

cell cycle

GI motility & secretion

Homeostasis

- positive feed back control example: childbirth (parturition)



Homeostasis

- Other examples of positive feedback loops?

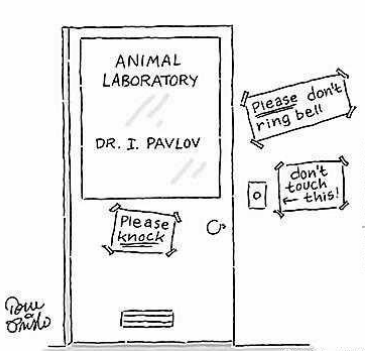
lactation

some enzyme production

hemostasis (blood clotting)

Homeostasis

- Feedforward loops?



Biological Energy

- What is the Biological Energy Currency?
  - Adenosine Triphosphate (ATP)
- Why?
- How is it made?

Structure v Function

- How are the two related?
- Can they be separated?

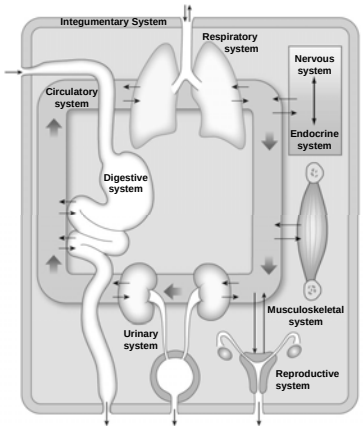
Communication

- Major theme in physiology
  - Forms
    - Electrical
    - Chemical
  - Between
    - Cell/cells
    - Tissues
    - Organs…
- Communication allows for the integration of physiology!

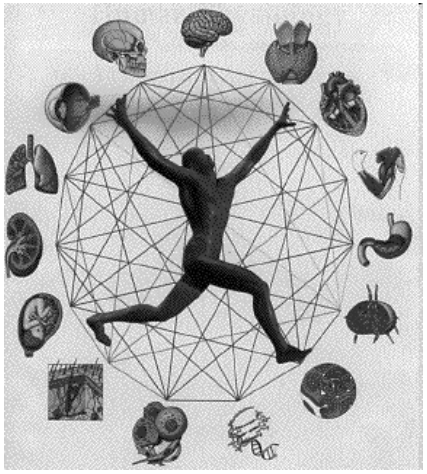
Integrated Physiology

- **What is it?**
- **How can we grasp it?**
- **Examples of a integrated physiology illustrations**

Integrated Physiology Illustrations



Integrated Physiology Illustrations



Biology 235 Graphic Syllabus

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