

Human Biology and Science



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Science Is Both a Body of Knowledge and a Process

- Science is the study of the natural world
- Science is two things
 - *Knowledge* about the natural world
 - The *process* used to acquire knowledge
 - Called the *scientific method*

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The Scientific Method Is a Process for Testing Ideas

- Steps in the scientific method
 - Observe and generalize
 - Formulate a hypothesis
 - Make a testable prediction
 - Experiment or observe
 - Modify the hypothesis as necessary and repeat

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The Scientific Method Is a Process for Testing Ideas

- 1) Observe and generalize
 - Make generalizations based on observations about the world with *inductive reasoning*
 - » 'Specific to general reasoning'
 - Observation: "Every winter in the past was colder than the preceding summer."
 - Generalization: "Winter will always be colder than summer."

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The Scientific Method Is a Process for Testing Ideas

- 2) Formulate a hypothesis
 - A *hypothesis* is a tentative statement about the natural world

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The Scientific Method Is a Process for Testing Ideas

- 3) Make a testable prediction
 - Hypotheses should be tested under many different conditions
 - Testable predictions
 - Should be based on the hypothesis
 - Should employ deductive reasoning
 - Are often in the form of "if...then" statements
 - Should be specific in order to be testable

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The Scientific Method Is a Process for Testing Ideas

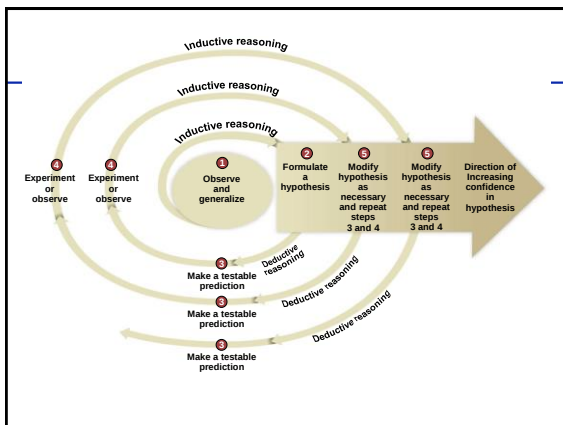
- 4) Experiment and observe
 - Truth or falsehood of prediction is tested by observation and experimentation
 - *Experiment*: A carefully planned and executed manipulation of the natural world.
 - In *controlled experiments*, all but one variable are accounted for
 - Placebo – “false treatment”

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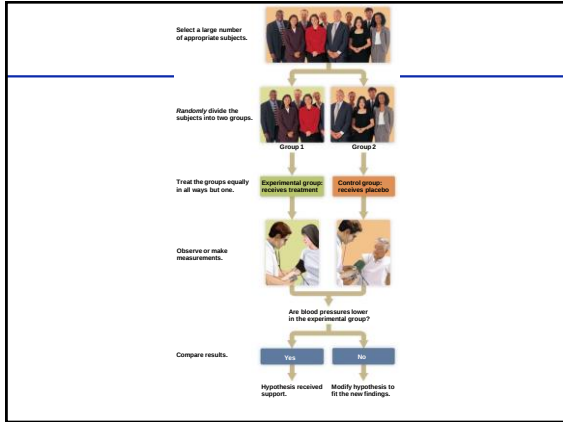
The Scientific Method Is a Process for Testing Ideas

- 5) Modify the hypothesis as necessary and repeat Steps 3 and 4
 - If prediction is false, the hypothesis must be modified.
 - If the prediction is true, only one small part of the hypothesis has been tested. Further testing required.
 - *Hypotheses cannot be proved true, only supported or disproved.*

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Making Findings Known

- Findings can be disseminated in
 - Peer-reviewed journals
 - Experts must approve articles before publication
 - Results are assumed to be valid only for conditions under which experiment was done
 - Popular press
 - Electronic publications
 - Internet is less regulated than print and broadcast media

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Hypothesis Becomes a Theory

- For a hypothesis to become a theory it must
 - Be broad
 - Be extensively tested
 - Be supported over time
 - Explain a broad range of facts
 - Have a high degree of reliability
- Theories may be refuted in the future

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Learning to Be a Critical Thinker

- Become a skeptic
 - Not everything you see is true
 - Who is stating it is true?
 - Are they paid for their opinion?
 - Most typical media outlets summarize the source data
 - Sources for science are peer-reviewed journals
 - Ex) *Nature* or *Science*

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Learning to Be a Critical Thinker

- Appreciate the value of statistics
 - Helps organize data
 - Determine confidence in data
- Learn to read graphs
 - Pictorial view of data

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Learning to Be a Critical Thinker

- Distinguish anecdotes from scientific evidence
 - Anecdotal is testimony or unverified report
 - Scientific is proven through experimentation
- Separate facts from conclusions
 - Conclusion is some ones judgment from the facts they have

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Learning to Be a Critical Thinker

- Understand the differences between correlation and causation
 - Two events may both occur at the same time but not be related
 - Therefore they are correlated but do not cause each other
 - Ex) Drownings and ice cream sales both increase at the same time
 - Correlated but do not cause each other

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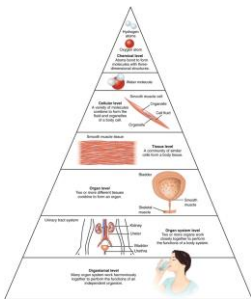
The Role of Science in Society

- Science improves technology and the human condition
 - Benefits from the *appliance* of technology
- Science has limits
 - Physical explanations in natural world
- Science helps us to make informed choices
 - Look at the facts and draw your own conclusions

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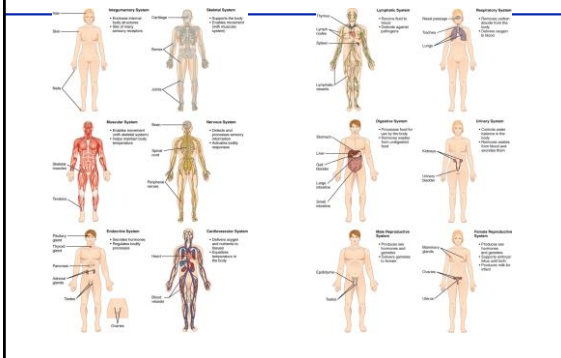
The Body

- **Levels of Structural Organization of the Human Body**
- The organization of the body often is discussed in terms of six distinct levels of increasing complexity.



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The Body

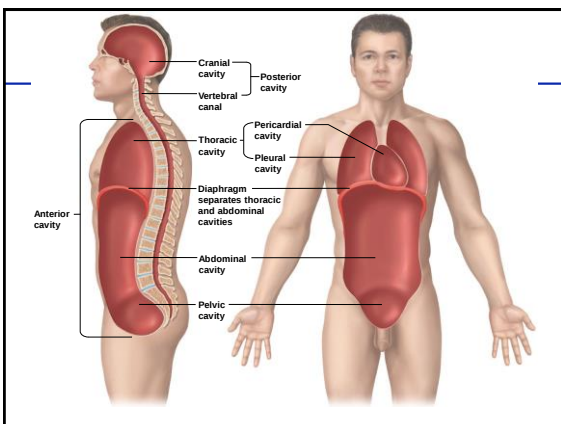


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Body Cavities

- Anterior cavity
 - Thoracic cavity
 - Two pleural cavities
 - Pericardial cavity
 - Abdominal cavity
 - Pelvic cavity
- Posterior cavity
 - Cranial cavity
 - Spinal cavity

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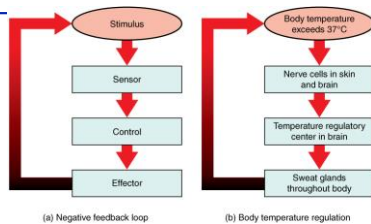
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Tissue Membranes

- **Serous membrane**
 - reduces friction between organs
- **Mucous membrane**
 - lubricates surface, captures debris
- **Synovial membrane**
 - lines spaces in movable joints
- **Cutaneous membrane**
 - skin

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Feedback – Negative Loop

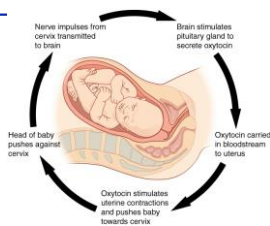


In a negative feedback loop, a stimulus—a deviation from a set point—is resisted through a physiological process that returns the body to homeostasis.

- (a) A negative feedback loop has four basic parts.
 (b) Body temperature is regulated by negative feedback.

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Feedback – Positive Loop



Normal childbirth is driven by a positive feedback loop. A positive feedback loop results in a change in the body's status, rather than a return to homeostasis.

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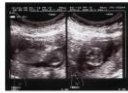
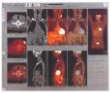
Medical Imaging – X-Ray



High energy electromagnetic radiation allows the internal structures of the body, such as bones, to be seen in X-rays like these.

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Medical Imaging



- (a) The results of a CT scan of the head are shown as successive transverse sections.
- (b) An MRI machine generates a magnetic field around a patient.
- (c) PET scans use radiopharmaceuticals to create images of active blood flow and physiologic activity of the organ or organs being targeted.
- (d) Ultrasound technology is used to monitor pregnancies because it is the least invasive of imaging techniques and uses no electromagnetic radiation.

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