

Human Biology and Science



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*

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

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.”

The Scientific Method Is a Process for Testing Ideas

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

The Scientific Method Is a Process for Testing Ideas

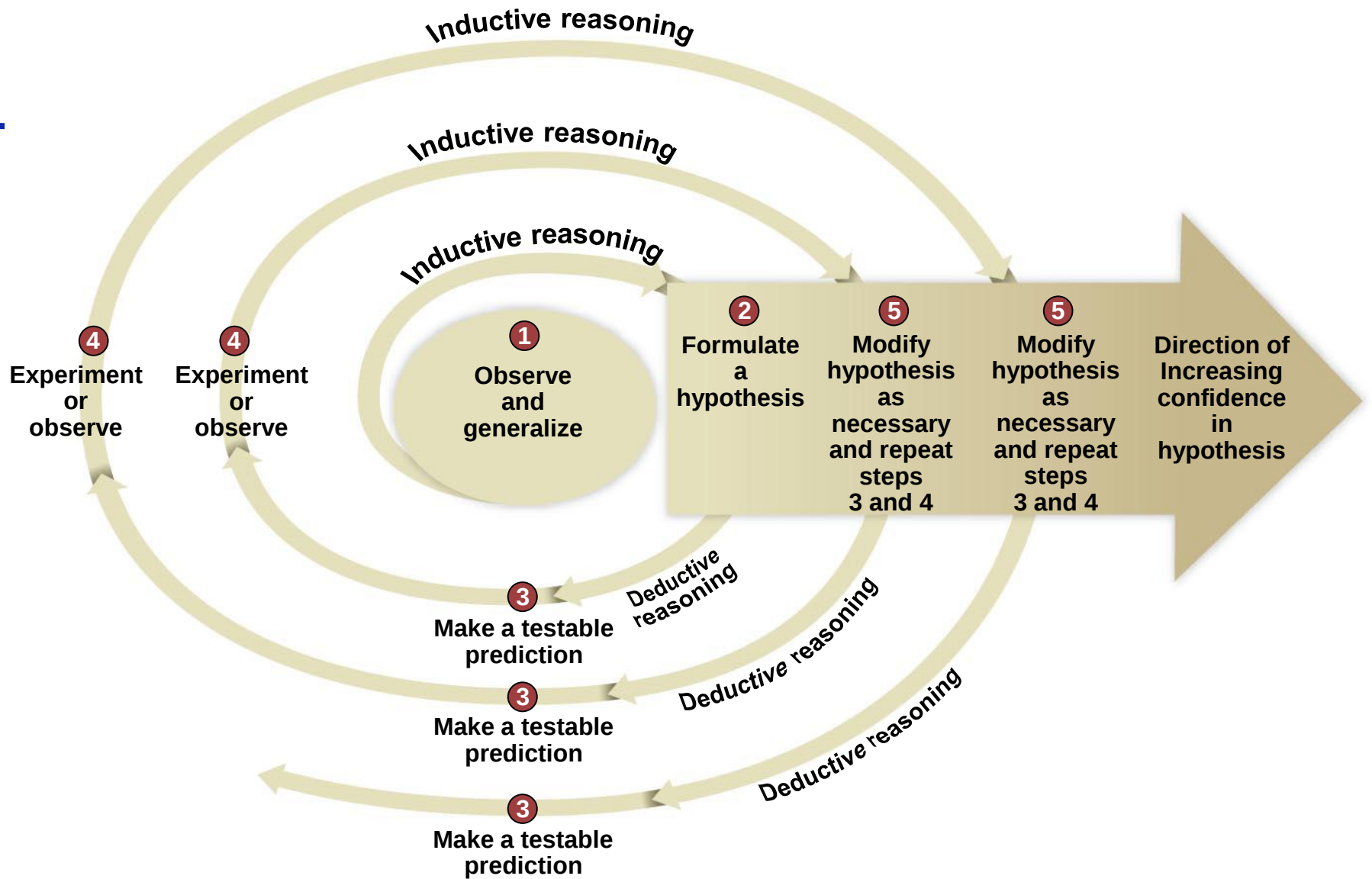
- 3) Make a testable prediction
 - Hypotheses should be tested under many different conditions
 - Testable predictions
 - Should be based on the hypothesis
 - Should employ deductive reasoning
 - Are often in the form of “if...then” statements
 - Should be specific in order to be testable

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”

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.*



Select a large number of appropriate subjects.



Randomly divide the subjects into two groups.



Group 1



Group 2

Treat the groups equally in all ways but one.

Experimental group:
receives treatment

Control group:
receives placebo

Observe or make measurements.



Are blood pressures lower
in the experimental group?

Compare results.

Yes

No

Hypothesis received
support.

Modify hypothesis to
fit the new findings.

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

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

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*

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

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

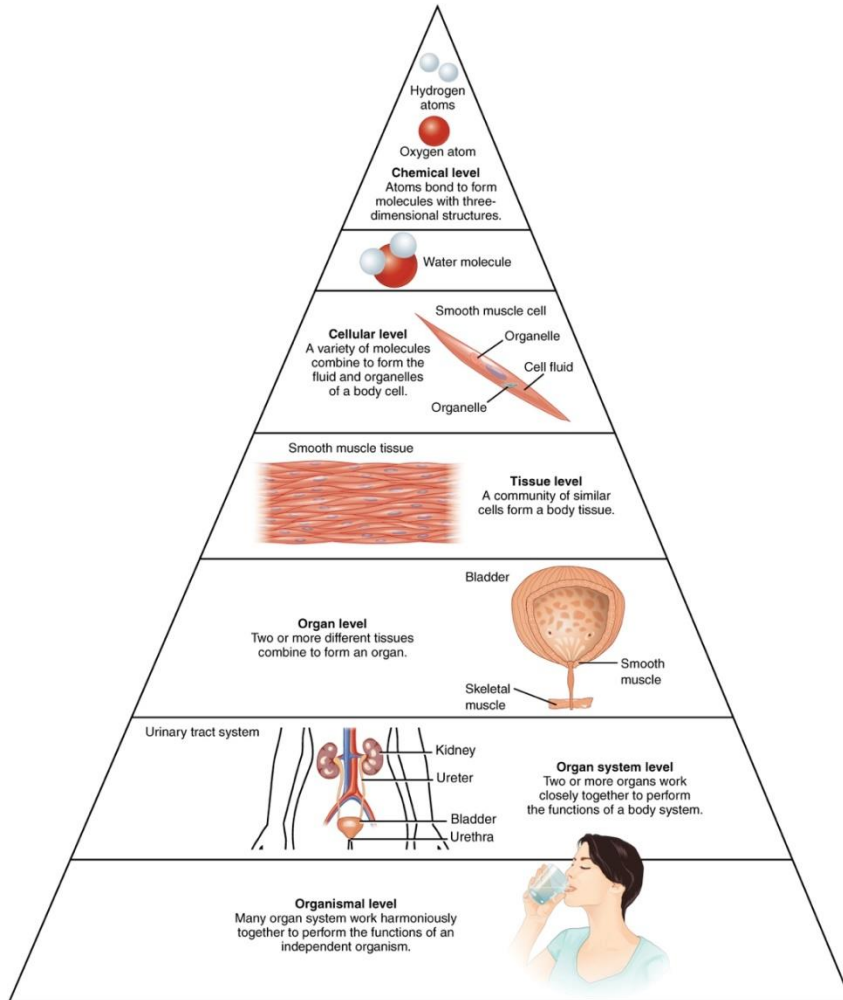
Learning to Be a Critical Thinker

- 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

The Role of Science in Society

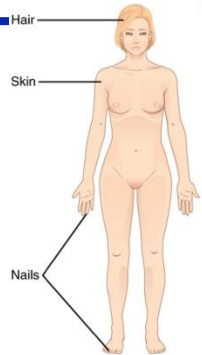
- Science improves technology and the human condition
 - Benefits from the *appliance* of technology
- Science has limits
 - Physical explanations in natural world
- Science helps us to make informed choices
 - Look at the facts and draw your own conclusions

The Body



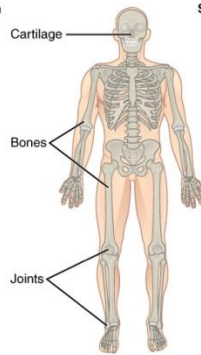
- **Levels of Structural Organization of the Human Body**
- The organization of the body often is discussed in terms of six distinct levels of increasing complexity.

The Body



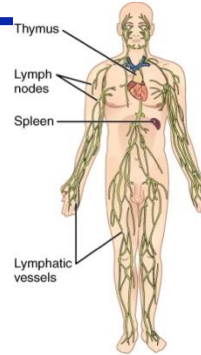
Integumentary System

- Encloses internal body structures
- Site of many sensory receptors



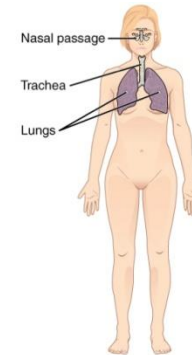
Skeletal System

- Supports the body
- Enables movement (with muscular system)



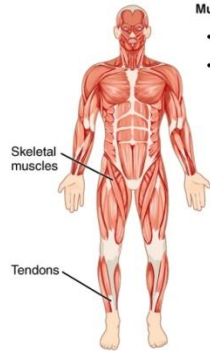
Lymphatic System

- Returns fluid to blood
- Defends against pathogens



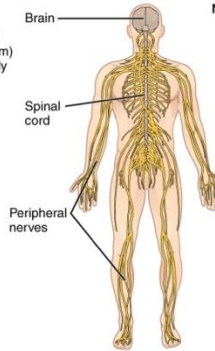
Respiratory System

- Removes carbon dioxide from the body
- Delivers oxygen to blood



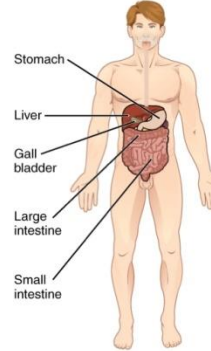
Muscular System

- Enables movement (with skeletal system)
- Helps maintain body temperature



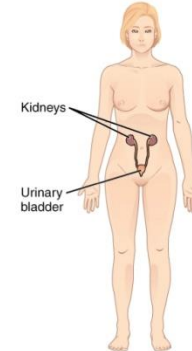
Nervous System

- Detects and processes sensory information
- Activates bodily responses



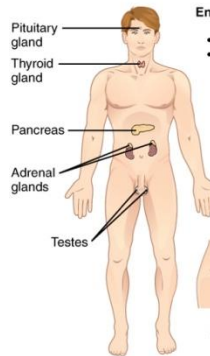
Digestive System

- Processes food for use by the body
- Removes wastes from undigested food



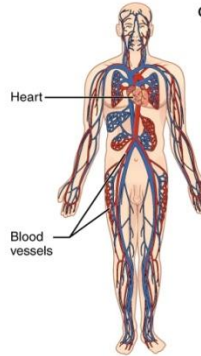
Urinary System

- Controls water balance in the body
- Removes wastes from blood and excretes them



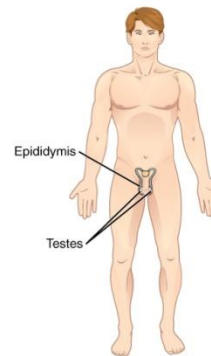
Endocrine System

- Secretes hormones
- Regulates bodily processes



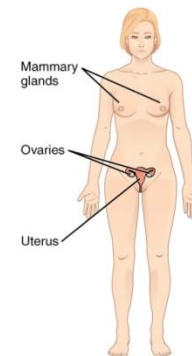
Cardiovascular System

- Delivers oxygen and nutrients to tissues
- Equalizes temperature in the body



Male Reproductive System

- Produces sex hormones and gametes
- Delivers gametes to female

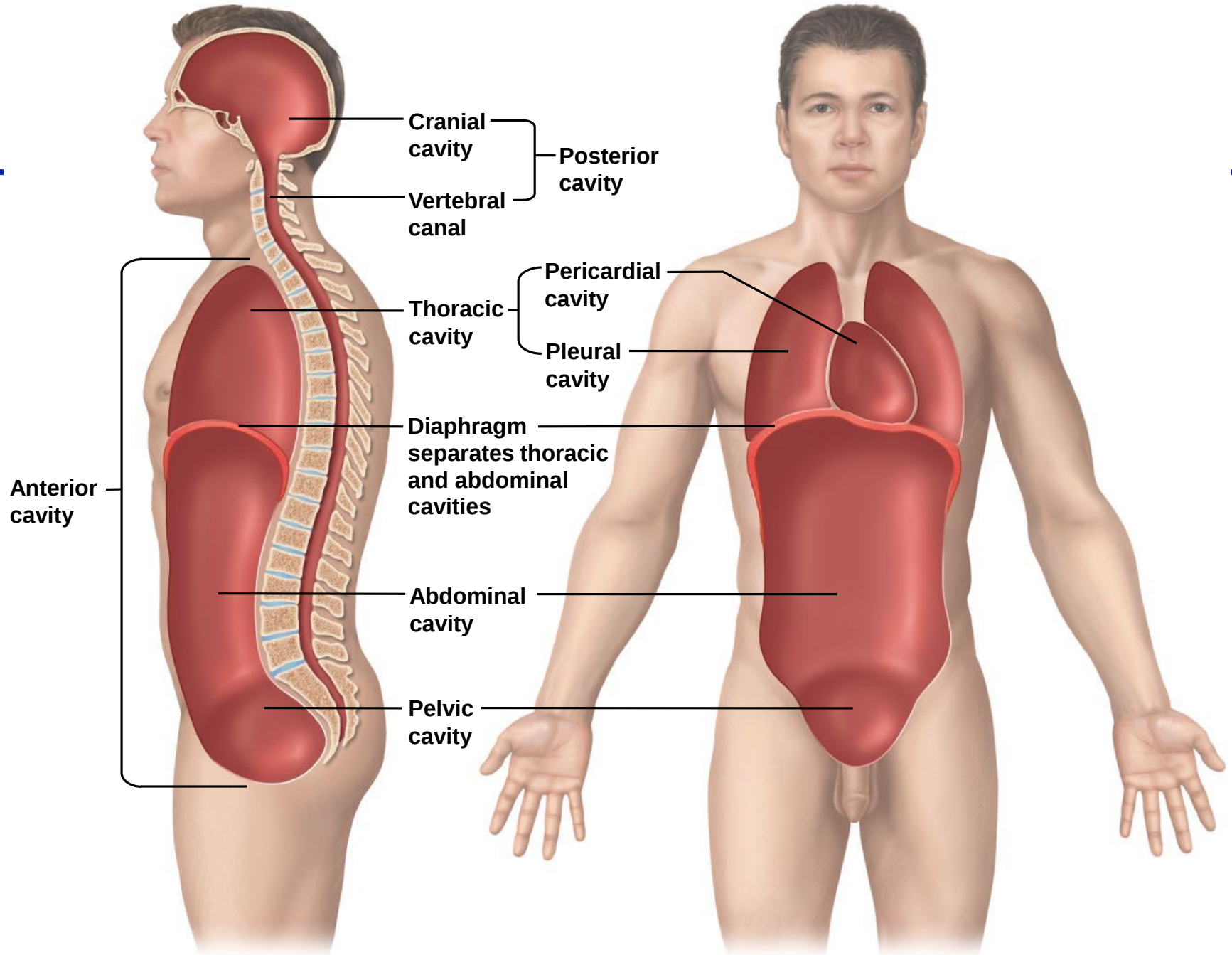


Female Reproductive System

- Produces sex hormones and gametes
- Supports embryo/fetus until birth
- Produces milk for infant

Body Cavities

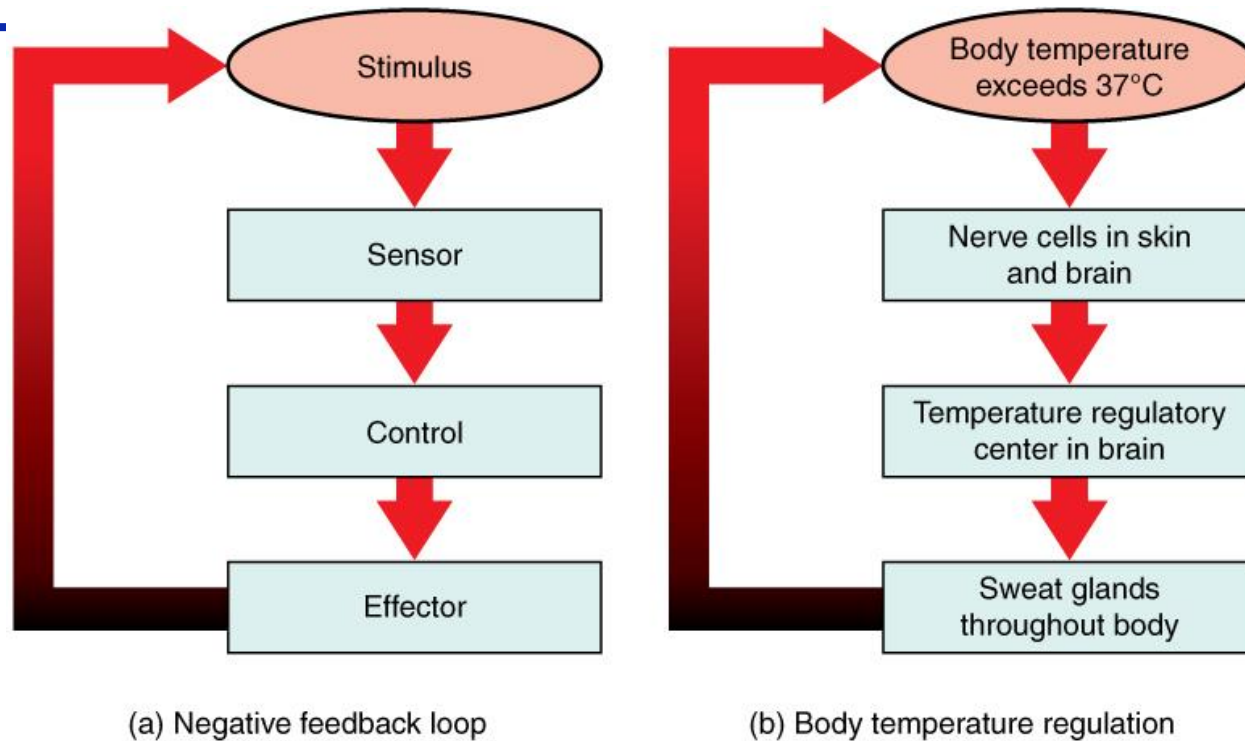
- Anterior cavity
 - Thoracic cavity
 - Two pleural cavities
 - Pericardial cavity
 - Abdominal cavity
 - Pelvic cavity
- Posterior cavity
 - Cranial cavity
 - Spinal cavity



Tissue Membranes

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

Feedback – Negative Loop

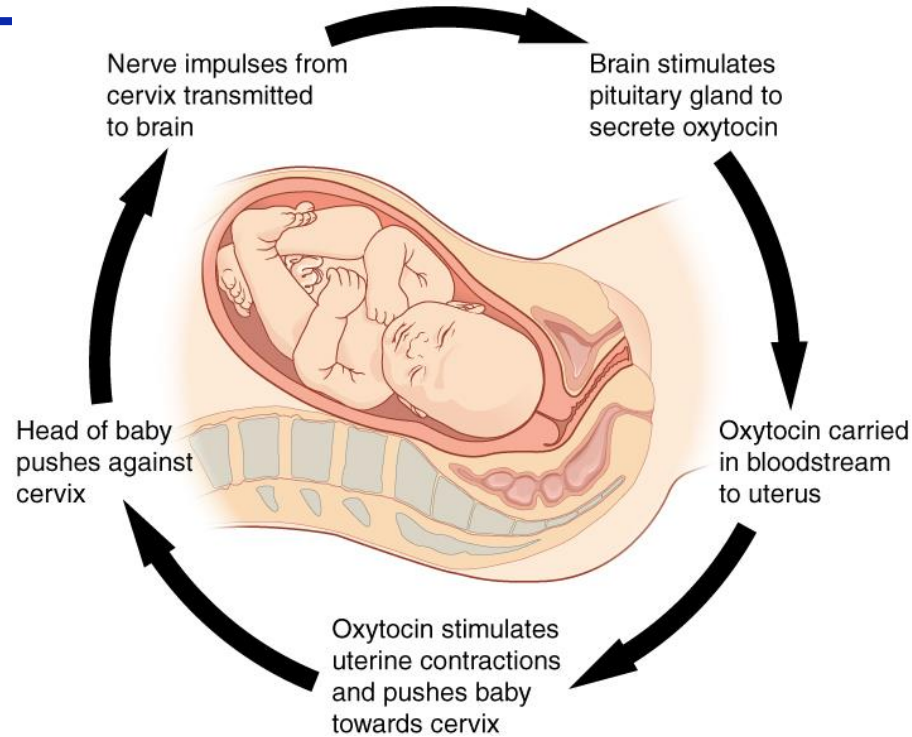


In a negative feedback loop, a stimulus—a deviation from a set point—is resisted through a physiological process that returns the body to homeostasis.

(a) A negative feedback loop has four basic parts.

(b) Body temperature is regulated by negative feedback.

Feedback – Positive Loop



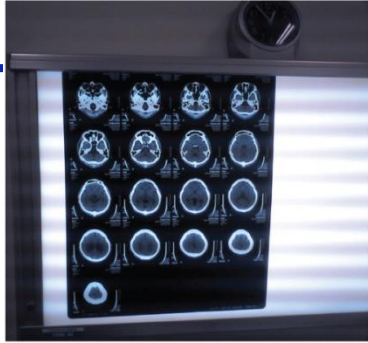
Normal childbirth is driven by a positive feedback loop. A positive feedback loop results in a change in the body's status, rather than a return to homeostasis.

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.

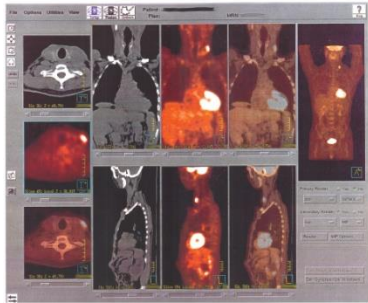
Medical Imaging



(a)



(b)



(c)



(d)

(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.