Biol 101

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Biol 101

- Attendance is expected.

- Small bonus points will be given randomly in class.
  - Bonus points, because they are an attendance incentive, cannot be made up for any reason.

- The lecture of the day will be posted on my website that morning.

Exams & grading

- Grades will be based on three exams and your lab points.
  - Missing three labs, or failing the lab section results in you failing the entire course.
- Test Format
  - Multiple Choice
  - True/False
  - Matching (w/ Diagrams)
  - Fill-in-the-blank / Short Answer
- Grades will be on a straight scale
  - No plusses or minuses.
  - 90% or higher = A, 80% - 89% = B, etc.

Biol101 contains a lot of material

- You will be covering material that includes
  - Evolution
  - Ecology
  - Biodiversity

- If your studying habits are 100% memorization
  - *You will not do well.*

  - Take advantage of all study materials given to you. I will put up useful materials on my website.

Biol101 contains a lot of material

- Know your learning style if you don't already

  - Link to where you can assess your learning study is on my website

  - This will help you learn how to study more effectively for your learning style.

  - <u>Study well, not hard!</u>

So to pass Biol101

- You should attend as many lectures as possible.

- Participate in the in-class activities.

- Read the book.

- Do well in the laboratory section

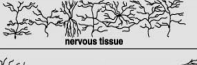 *Remember, failure in lab results in failure for the entire course!*

Any questions?

Chapter 1

How do Scientists study life?

- Life is studied at different levels of organization.

Topics covered in Biol 101:

Multicellular Organism	An individual living thing composed of many cells	pronghorn antelope
Organ System	Two or more organs working together in the execution of a specific bodily function	the nervous system
Organ	A structure usually composed of several tissue types that form a functional unit	the brain
Tissue	A group of similar cells that perform a specific function	nervous tissue
Cell	The smallest unit of life	nerve cell

How do scientists study life?

- Biology inquiry requires:
  - The Scientific Method

Nature of biological inquiry

- The Scientific method
  - Observation
    - ❖ Observe an aspect of nature.
  - Hypotheses
    - ❖ Develop a hypothesis based on the observation.
  - Make a prediction based on the hypothesis
    - ❖ An if-then statement indicating what you would find if your hypothesis is true.
  - Experiment to test hypothesis
    - ❖ Develop an experiment for prediction to see if it is true.

Nature of biological inquiry

- Devise new hypotheses/tests if your original experiment fails to accept your original idea.
- Repeat tests to see if your hypotheses are robust.
  - Good hypotheses can withstand many different types of tests = also known as repeatability.
    - ❖ Cold fusion: A good hypothesis?
    - ❖ *New data suggests that it might be!*
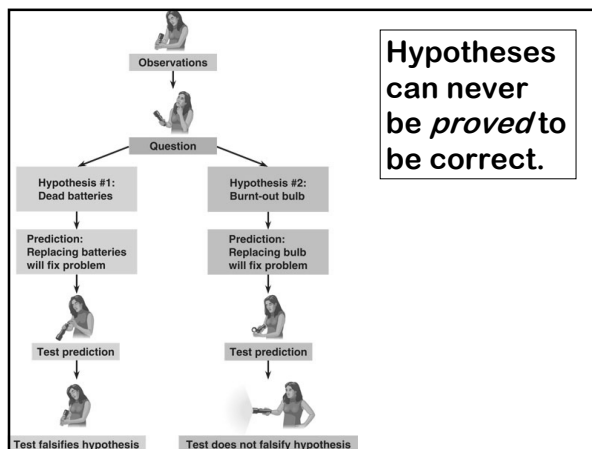- Make conclusions based on all tests' results.

Scientific theory

- Scientific theory
  - Scientific theory is based on hypotheses that still stand after many tests.

  - Scientific theory must be tested. Untestable ideas are not scientific, but speculative.
    - Example/ Dinosaurs spoke English
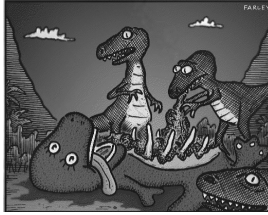
Power of experimental tests

- Experimental test have the following components:
  - Variable to be tested

  - Experimental group
    - Group that tests the variable

  - Control group
    - Group that does NOT test the variable

Observations

Question

Hypothesis #1:
Dead batteries

Hypothesis #2:
Burnt-out bulb

Prediction:
Replacing batteries will fix problem

Prediction:
Replacing bulb will fix problem

Test prediction

Test prediction

Test falsifies hypothesis

Test does not falsify hypothesis

Hypotheses can never be *proved* to be correct.

3rd hypothesis of flashlight problems

Evil flashlight fairies destroy flashlights.

Real life example: Olestra

- What is Olestra?
  - A fat replacement that cannot be digested by humans.

- Normal lipids: Glycerol molecule with 3 fatty acid chains (triglyceride)

- Olestra: Sucrose molecule with 6 – 8 fatty acid chains.
  - Large molecule cannot pass through the intestinal wall.
- Has the same taste and mouthfeel as normal lipids.
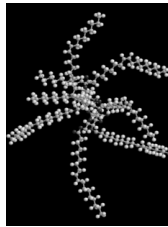
Real life example: Olestra

- <u>Observation</u>: People who ate Olestra fat replacement later had cramps
- <u>Hypothesis</u>: Olestra causes cramps.

<u>Prediction</u>: People who ate Olestra laced chips will develop cramps.

<u>Test:</u>
      Variable: ?
      Experimental group: ?
      Control group: ?

Olestra test

- Variable = Presence of olestra.

- Experimental group = eats olestra laced chips.

- Control group = eats chips with normal fat.
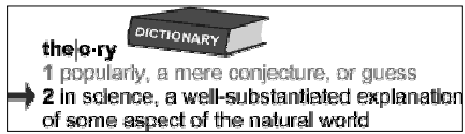
- Conclusions: based on your data.

Olestra test

- 100 people who ate Olestra laced chips developed cramps.

- 2 people who ate normal chips developed cramps.

- *What is your conclusions??*

Bias in testing

- One reason you want to repeat your tests is because of errors that can bias your results.
  - Sampling error: when data taken from a sample differs from the data taken from the entire population.
    - ❖ This error is most prominent when sample sizes are small.

    - ❖ Most researchers attempt to obtain as many individuals as feasible for this reason.

Theories in Science

theory

1 popularly, a mere conjecture, or guess
2 In science, a well-substantiated explanation of some aspect of the natural world

How does it differ from a hypothesis?

- **Much broader in scope**
- **Generates hypotheses**
- **Supported by much larger body of evidence**

Examples?

- Examples of theories?

- Examples of hypotheses?

How life is connected to each other

Evolutionary view of diversity

- Mutations create trait variations
  - Red hair vs black hair.
- Evolution
  - Change in gene frequencies over time
  - Changes due to adaptive fitness of one trait over another.
    - ❖ Natural selection

Evolution: the unifying theory of biology

- Definition of evolution: Change in gene frequencies in a population over time.

  - Example 1: Antibiotic resistance in *Staphlococcus aureus.* From 1943 – present, S. aureus went from highly sensitive to penicillin to highly resistant to most antibiotics.

  - Example 2: American Amish population have seen increase in several genetic conditions in their 300 year history.

Evolutionary view

- Mutations create trait variations in populations
  - Example: Red hair vs black hair.
  - The ultimate source of genetic variation.
- Variations are passed down to future generations
  - Usually due to adaptive fitness of one trait over another.
    - ❖ Black rabbits more easily seen in the snowy north results in genes coding for black pigments being less frequent over the generations.
- Natural selection
  - The process when environmental differences results in changes of the gene frequencies in a population of organisms.

Evolutionary view of diversity

- Natural selection
  - When changes in the environment changes the gene frequencies of population of organisms.

Eat me!

Try and find me!
I dare you.

Man also drives evolution

- Artificial selection is the selection of a genetic trait over others by human breeders, not nature.

Artificial selection

- Sometimes artificial selection goes wrong…
  - Just like natural selection can go wrong!

Valuable silver fox coloring, but skittish and aggressive

Tame silver fox, but spotted. Not valuable for furs.

Selection for friendly behavior also selected genes that code for spotted coats!

Selection and evolution

- Evolution: Change in gene frequencies over time.

- Molecular view: accumulation of mutations change organisms to the point where they diverge.

  - **Closely** related species: Few differences between their genomes.

  - **Distantly** related species: Many differences between their genomes.

Molecular data indicates surprising relationships

Molecular data indicates surprising relationships
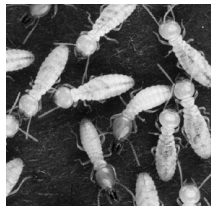
Termites, long believed to be a separate insect order, are now considered highly specialized wood roaches.

Characteristics of life

Characteristics of living things

- DNA

- Energy

- Energy and Life's organization

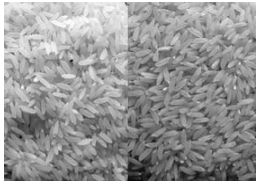- Life's responsiveness to change

DNA

- All living organisms use DNA in some capacity.
  - "semi-living" organisms, like viruses, use DNA or RNA to reproduce.

- DNA is used by most organisms to produce amino acids.
  - Enzymes
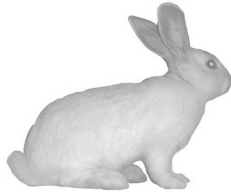 - Muscles
  - Collagen/keratin

Genetic code

- All living organisms use the same genetic code
  - The nucleotides A, C, G, T

Golden rice (left) has had beta-carotene precursors transferred from daffodils.

Alba had a jellyfish gene for fluorescence incorporated in her genome.

Energy utilization

Energy

- Maintaining life requires energy
  - Even in death, energy is required to decompose.

- Metabolism
  - The process of how cells acquire and uses energy

- Living things often acquire energy through eating other organisms.
  - Plants, however, can produce their own food with sunlight.

Energy flow in life
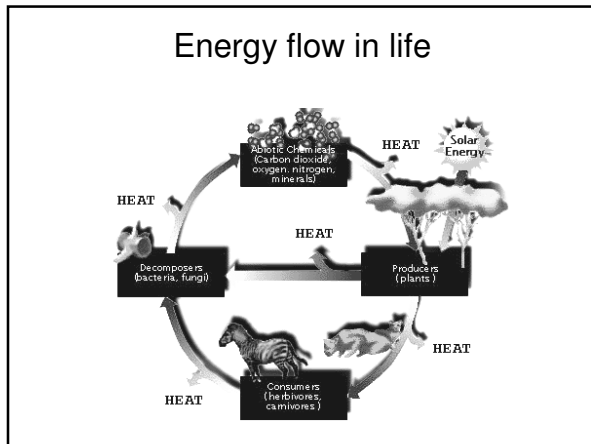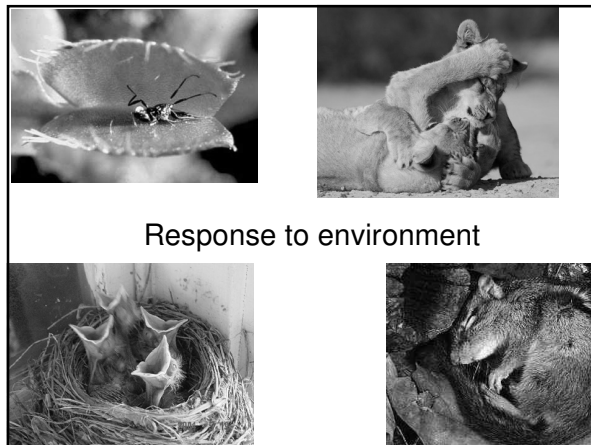
Response to environment

Responding to change

- All things respond to the environment
  - But only living things can make responses to change by using receptors.

- Receptors detect stimuli in environment.
  - Living things respond to the stimuli to create changes to bring the body back homeostasis.

- Homeostasis: the normal operating condition of an organism.

Receptors

- Types of receptors:
  - Mechanical receptors sense physical pain

  - Biochemical receptors sense changes in blood chemistry
    - Example/ rising/lowering blood sugar levels

  - Thermoreceptors sense hot and cold

  - Photoreceptors respond to light