Chapter 1 - Introduction to Ecology

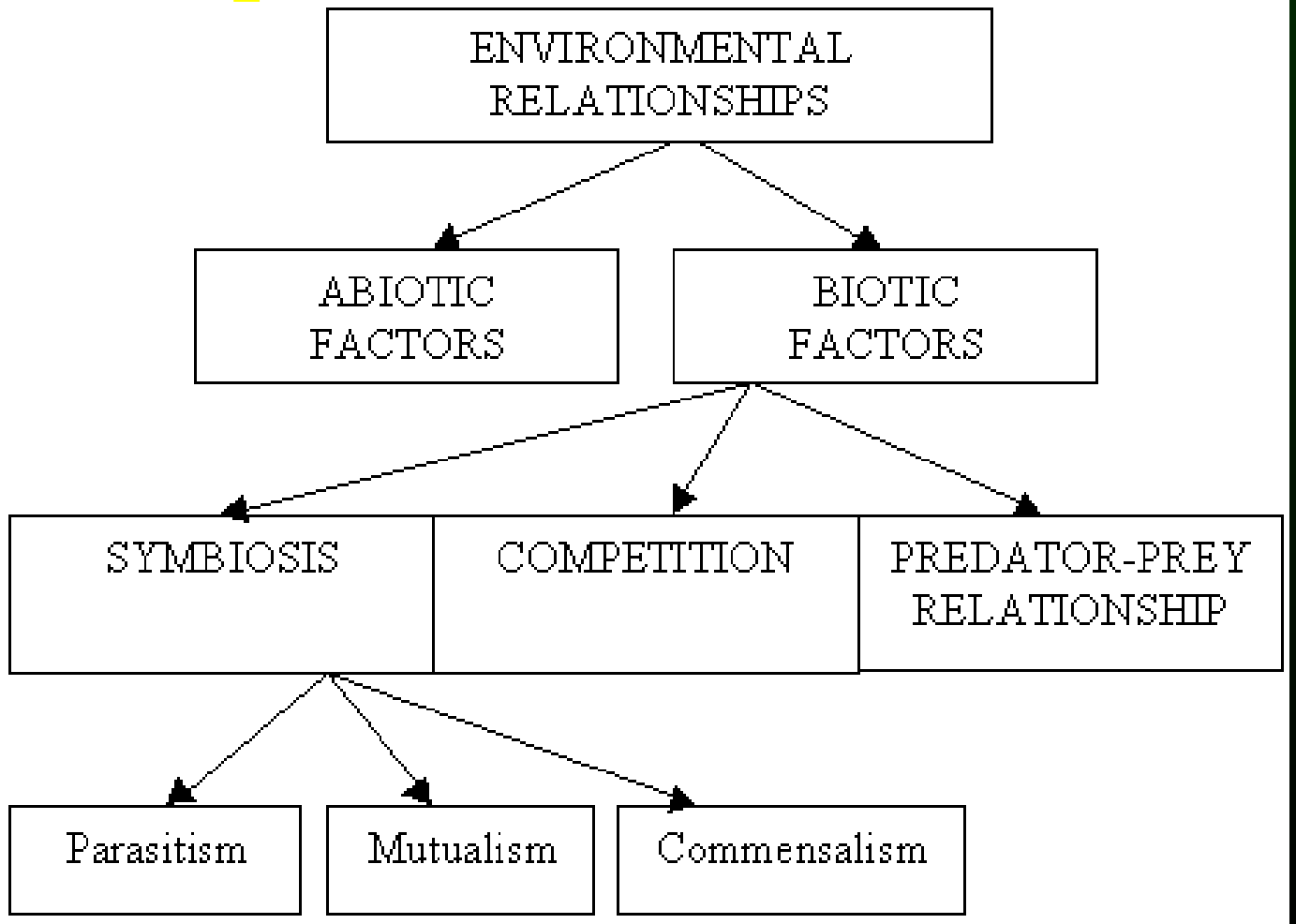
What is Ecology???

From the Greek Oikos = House
Ology = study of

Ecology = the study of the relationship between organisms and their environment…quite a large area of study!!!

Overview of Ecology

From individuals to the biosphere



NASA

Biosphere

What role does concentration of atmospheric CO_2 play in the regulation of global temperature?

NASA

Region

How has geologic history influenced regional diversity within certain groups of organisms?

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Landscape

How do vegetated corridors affect the rate of movement by mammals among isolated forest fragments?

Photo by Gary Wilson/USDA Natural Resources Conservation Service

Ecosystem

How does fire affect nutrient availability in grassland ecosystems?

© Corbis RF

Community

How does disturbance influence the number of mammal species in African grasslands?

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Interactions

What evolutionary benefit do zebras gain by allowing birds to remove parasites?

© Corbis RF

Population

What factors control zebra populations?

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Individuals

How do zebras regulate their internal water balance?

- **Organism**
  - An individual consisting of one or more cells
- **Population**
  - Individuals of the same species in the same area
- **Community**
  - Populations of all species in the same area
- **Ecosystem**
  - A community and its environment
- **Biosphere**
  - All regions of the Earth where organisms live

organism

population

community

ecosystem

biosphere

There are many different branches of ecology!

Renfield ecology

The Scope of Ecology

- Ecology: Study of relationships between organisms and the environment.
  - Wide variety of approaches.
    - Large temporal and spatial scales.
      - Field
      - Lab
      - Observational
      - Manipulative

Ecology is easy!!!

- Give me an organism!
- Give me a question you can ask about that organism that has something to do with its environment
- That's ecology…it's easy…that's why I went into this field!!!

Ecology uses the scientific method

What is science???

- The term “science” comes from the Latin verb “scire” meaning to know. Science refers to knowledge that can be demonstrated in the concrete, factual realm of reality. Matters that are inherently outside of objective reality, those things that are subjective or internal and cannot be demonstrated objectively, are outside of the realm of natural science.

GIVE ME EXAMPLES OF SUBJECTS OUTSIDE OF SCIENCE!

- Science is distinct from the humanities and the arts, which also deal with facts and the concrete but in the context of values and aesthetics. A piece of art of literature communicates large through an appeal to human emotions and sense of beauty or importance. This is not to say that the truth so communicated is not valid; it is simply not the subject of method of science.

GIVE ME EXAMPLES OF ART AND WHY IT’S NOT SCIENCE!

- Science is distinct from human law, which also deals with facts, but for the purpose of establishing justice, right and wrong, ethics. Scientists, being human, often find themselves dealing with ethical questions in their work, but ethics is not the subject of their work. Science itself is amoral. It exists purely to know what is.

WHY IS IT IMPORTANT THAT ETHICS STAY OUT OF SCIENCE?

What is science?

- Science is distinct from theology and religion because it does not deal with the spiritual and the supernatural. The spiritual is not demonstrable, objectively, and the supernatural is by definition outside of the natural or objective reality. Furthermore, one can explain all things by invoking the supernatural, whereas science can never explain all things. Science is inherently uncertain, while theology is certain.

DOES THIS MEAN THAT SCIENCE IS ANTI-RELIGION AND RELIGION IS ANTI-SCIENCE?

- Scientific inquiry is characterized by objectivity. A scientist, ideally, does not become attached to a certain hypothesis and seek to prove it. Rather, he or she adopts multiple working hypotheses and seeks to eliminate them. Scientists also accept that there will always remain a degree of uncertainty in their conclusions. It is the hallmark of a good scientific principle or theory that one can state clearly how it could be disproved. “Science is about inquiry and discovery, unearthing the unanticipated, spotting surprising relationships in complex systems, confronting and coping with divergent streams of evidence, looking at data skeptically and allowing knowledge to accumulate over time.”
- **SCIENCE ROCKS!!!**

Class Activity

- In groups, write one thing down that can be proved using science. Why can it be proved scientifically?

- Write one thing down that cannot be proved using science. Why can't it be proved scientifically?

You used the scientific method!!! Yay!!!

What is the Scientific Method?

1. Observe phenomenon
2. Develop hypotheses – a testable explanation of the observed phenomenon
3. Make predictions
4. Devise test of predictions - experimentation
5. Carry out test and analyze results

A Scientific Approach – you use the scientific method all the time, but don't know it!!!

1. Observe phenomenon
2. Develop hypotheses – a testable explanation of the observed phenomenon
3. Make predictions
4. Devise test of predictions - experimentation
5. Carry out test and analyze results

- **Your car won't start!!!**
- **My battery is dead!!!**
- **If I replace the battery, my car will start!!!**
- **I'll put a new battery in and see if my car will start!!!**
- **You put a battery in, and cross your fingers!!!**

Experimental Design

- Experimental group
  - Group with a single variable characteristic to be tested against a control group in an experiment
- Control group
  - Group identical to the experimental group, except for the variable being tested
- Variable
  - A single characteristic in a set of individuals that differs from the control group in an experiment

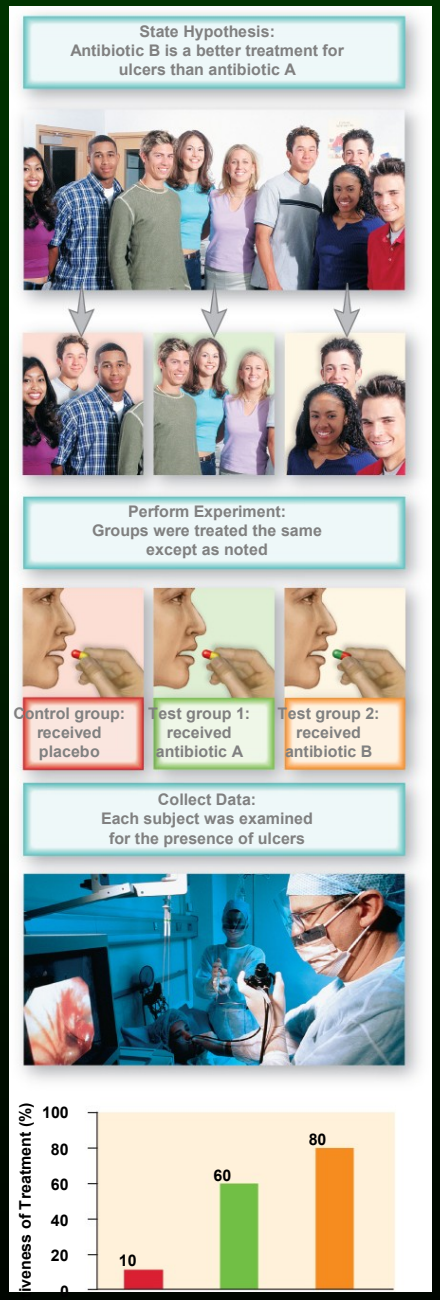
An experimental example!

- Hypothesis : Antibiotic B is better than Antibiotic A in current use for the treatment of ulcers.
- 3 experimental groups
  - Reduce possible variances by randomly dividing large group.
  - Control group receives placebo.

What is the variable???

Which is the experimental group?

Which is the control group?



Experimental Design

- Sampling error
  - Nonrepresentative sample skews results
  - Minimize by using large samples
  - The goal is to reduce possible errors as much as possible in any experiment

Sampling error illustration!

Scientific Theory

- A hypothesis that has been tested for its predictive power many times and has not yet been found incorrect

- Has wide-ranging explanatory power
  - Darwin's Theory of Evolution by Natural Selection

Limits of Science

- Scientific approach cannot provide answers to subjective questions
- Cannot provide moral, aesthetic, or philosophical standards
- The fact that theories can change based on new discoveries is one of science's greatest strengths!

Assignment #1 Due by Friday, April 15th. It MUST be submitted by 11:55 pm on the 15th. Late submissions WON'T be accepted! Turn in via Catalyst website!!!

Contact me with any problems/questions

Take your group “scientific” idea, and write up a way you can test your hypothesis. Basically, what experiment would you run to test it? There are no wrong answers, only ones that don’t show effort!