A Survey of the Biology of Animals Without Backbones

1. We will consider:
   a. The “higher” invertebrate animal phyla using selected taxa to illustrate concepts in:
      1. Evolution
      2. Systematics
      3. Physiology
      4. Morphology
      5. Life history
      6. Ecology
      7. Behavior
To give you an appreciation for animals that make up >95% of all animal species!!!

My Goal

Biology as a Scientific Discipline

1. A conceptual means for learning about living things

   a. You will see that this framework is not much different from common sense.
   b. A conceptual foundation built on an understanding of the process of natural selection.

My Goals for this Course

1. Provide you with:
   a. increased understanding and appreciation of animal life on this planet
   b. factual and conceptual tools to become professional biological scientists:
      1. botanists, zoologists, geneticists, psychologists
      2. physicians, dentists, veterinarians, etc.
Please Note:
1. This is the second part of a two-part course
   a. Part I: Invertebrate Origins ->
      Blastocoelomates.
   b. Part II: Lophophores & other derived Protostomes (annelids, molluscs,
      arthropods).

Some Material Will Overlap
1. Also some information will be presented with the assumption that you know something about “lower” inverts.
   a. You may need to do some extra work to keep up.
   b. I recommend reading the early chapters of B&B for this information.

Syllabus
1. Be sure to read it over
2. Additional copies are available on the class website.
3. Note: Freshpersons are not eligible for this class.
4. Questions?
Laboratory

1. Laboratory will meet once per week in BS 328.
2. Your TA is Raena Cota
3. Most labs will involve examination of live or preserved material.
   a. Are designed to give you a feel for *invertebrate diversity*

Laboratory

1. Some labs will involve procedures to examine some aspect of living invertebrate biology
2. Some labs may involve field trips to locations where invertebrates are found.
   a. One of these may require that you leave in the morning on the day of your lab - then return that afternoon.

Field Trips

1. Traditionally, this course is associate with a trip to the Gulf of California, Mexico (BIO 227).
2. This year, the trip IS scheduled!!!
About Me

- B.S. University of Michigan 1976.
- M.S. University of New Mexico 1979.
- Ph.D., University of California, Berkeley 1987.
- Postdoctoral Associate, University of California, Riverside, 1987-88.
- Postdoctoral Associate, University of Chicago 1988-90.

What Science is NOT:

1. NOT magic or metaphysical;
Science only deals with what can be directly observed.

2. NOT evil or good;
Science is incapable of making value judgments.

3. NOT concerned with truth;
Truth is absolute; there are no absolutes in science.
What Science is NOT:

4. NOT judgmental in the philosophical sense
There is no right or wrong, only tendencies; some tendencies are more convincing than others.

If these are what science is NOT, what IS science?

What Science IS

A way of finding out how and why the universe works the way it does.

“A way of knowing."
John A. Moore.

Science Accomplishes This By:

1. Discovering facts about the universe
2. Organizing them into conceptual schemes called:
   a. Hypotheses
   b. Theories
   c. Laws
This Process is Called the Hypothetico-Deductive Method

But as T. H. Huxley said, science is really just “trained, organized common-sense.”

Trained, Organized Common Sense

“Science is...nothing but trained and organized common sense, differing from the latter only as a veteran may differ from a raw recruit; and its methods differ from those of common sense only so far as the guardsman’s cut and thrust differ from the manner in which a savage shields his club.”

T. H. Huxley, 1825-1895.

This Deductive Approach is Extremely Powerful

1. It generates yes/no answers; therefore eliminates possibilities.
2. It reveals what appears to be true and what is not; therefore it allows us to order our perceptions.
3. It permits classification of phenomena; therefore permits understanding.
Science is Powerful: Why?

1. It is RATIONAL not RELATIVISTIC.
2. It REDUCES rather than INCREASES the number of possible explanations.
3. It promotes HONESTY and EVIDENCE, not simply force of CLEVER ARGUMENT.

The Components of this Approach:

1. Observation
2. Generalization
3. Hypothesis formation
4. Hypothesis testing
5. Conclusion (and reformulation of hypothesis)

Science and Human Perception

"Man's brain, like the rest of him, may be looked upon as a bundle of adaptations. But what it is adapted to has never been self-evident. We are anything but a mechanism set up to perceive the truth for its own sake. Rather, we have evolved a nervous system that acts in the interest of our gonads, and one attuned to the demands of reproductive competition. If fools are more prolific than wise men, then to that degree folly will be favored by selection. And if ignorance aids in obtaining a mate, then men and women will tend to be ignorant. In order for so imperfect an instrument as a human brain to perceive the world as it really is, a great deal of self-discipline must be imposed."

Michael T. Ghiselin, 1969
The Rules

1. Phenomena must be OBSERVABLE
   a. Directly or indirectly
   b. Observability prevents bias.
   c. Limits the number of possible interpretations of results.
   d. Results OTHER THAN those predicted justify revision of the current hypothesis.

Combining volumes of H₂ and O₂:
1. We can’t SEE them combine.
2. But we CAN predict certain events based on what is know about free energy and electron interactions.
3. Predictable amounts of heat and H₂O will be produced.
4. Results OTHER than those predicted would be cause for revision of hypotheses.

The Rules

2. Hypotheses must be FALSIFIABLE – i.e., “testable”
   a. The type of data that will demonstrate the hypothesis to be untrue, must be clearly identified before any data are collected.
   b. Leads to ideas that make sense under a variety of circumstances.
   c. Leads to the hierarchical structure of scientific arguments.
   d. Usually provides the simplest possible explanations.
Darwin and Natural Selection:

“If it can be shown that a single characteristic of one species exists for the sole benefit of another, it would annihilate my hypothesis, for such could not be produced by natural selection.”

The Rules

2. FALSIFIABILITY

e. Falsification is necessary to prevent bias.
   1. logical arguments can lead to false conclusions.
   2. this is also why science is incapable of considering value or moral judgements.
   3. they are not observable, not falsifiable.

The Rules

3. Science must be PRAGMATIC

a. An hypothesis is considered true only until a more comprehensive one comes along.

b. Science is thus, in principle, non-dogmatic and self-correcting.
The Rules

4. Science must be HONEST
   a. "What is the evidence?"
   b. Accumulated evidence (honestly given) permits recognition of patterns.
   c. The system breaks down with lies or bad information.
   d. Also, science is HARD WORK!
   e. This is why cheaters, liars, plagiarizers, and data-fudgers are so relentlessly exposed and eliminated by scientists.

These fundamentals of science

Amount to “trained, organized common sense”

They are the basis of scientific understanding

They also provide solid values for our society