BIO 221
Invertebrate Zoology I
Spring 2010

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Northern Arizona University

http://www4.nau.edu/isopod

Lecture 1

Course Information

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Course Website

http://www4.nau.edu/isopod
Current Teaching -> BIO 221

All course information and updates will be posted there.
Lecture pdfs will be available there also, usually the day before lecture.
Lecture pdfs also posted on VISTA

A Survey of the Biology of Animals Without Backbones

1. We will consider:

a. The "lower" 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

My Plan for this Course

1. **To 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.

Understanding These Principles

May seem somewhat removed from what you may expect for yourself after watching "*Grey's Anatomy*" or reading *"All Creatures Great and Small."*

However, in a medical/scientific career you *must* be:

a. Skilled observers of detail.

b. Accurate record keepers (including diagrams).

c. Critical thinkers/diagnosticians.

d. Managers of large mental databases.

e. Able to *apply* your knowledge in practical situations.

You *must* develop these skills in this class to do well.

In this course and on exams I will expect you to be:

a. Skilled observers of detail.

b. Accurate record keepers (including diagrams).

c. Critical thinkers/diagnosticians.

d. Managers of large mental databases.

e. Able to *apply* your knowledge in practical situations.

Syllabus

1. Be sure to read it over
2. Additional copies are available on the class website (http://www4.nau.edu/isopod/)
3. Note: Freshmen, undeclared majors are *not eligible* for this class.

Textbooks and Reading

1. Textbooks are in the bookstore; Laboratory manuals are at University Text and Tools. *They are Required*.
2. PDF copies of Chapter 1 from Manual is available on the class website.
3. Additional readings for the course are also posted here.
4. Questions?

Laboratory

1. Laboratory will meet once per week in BS 146 (Tuesday 1-4, 4-7).
2. Your TA is ***Rachel Durben***
3. Most labs will involve examination of slides or preserved material; as much live material as we can get.
4. Labs are designed to give you a feel for invertebrate diversity.

Laboratory, continued

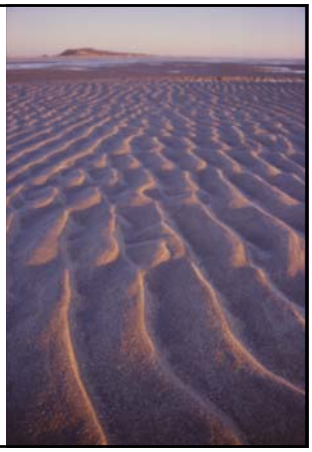
1. Anything presented in laboratory is fair game for practical exams.
2. Information presented in lecture and laboratory will overlap considerably.
3. The best strategy is to learn as much as you can – "Know Everything!"
4. Consider this an opportunity to learn how your brain retains information.

Field Trips

1. A possible field trip to Kohls's Ranch.
2. An afternoon field trip to Payson, AZ.
3. More details to follow.

Field Trips

1. This course is associated with a trip to the Gulf of California, Mexico (BIO 227).
2. This year, the trip IS scheduled 24-28 February 2010



About Me

- B.S., Zoology, University of Michigan 1976.
- M.S., Biology, University of New Mexico 1979.
- Ph.D., Zoology, University of California, Berkeley 1987.
- Postdoctoral Associate, Biochemical Genetics, University of California, Riverside, 1987-88.
- Postdoctoral Associate, Theoretical Population Genetics, University of Chicago, 1988-90.
- Northern Arizona University 1990-present

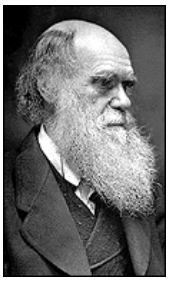
Biology as a Scientific Discipline

1. A conceptual means for learning about living things

a. You will see that this framework is not much different from common sense.

b. Foundation built on an understanding of the process of natural selection.

Natural Selection



The current hypothesis for explaining biological diversity

Crystalized by Charles Darwin and Alfred R. Wallace in 1858.

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, no absolutes 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

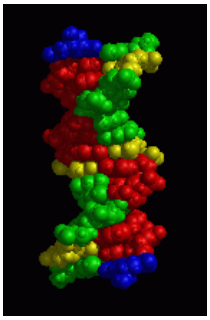
But as T. H. Huxley said, science is really just ***"trained, organized common-sense."***

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.

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 H_2 and O_2 :

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 H_2O 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.

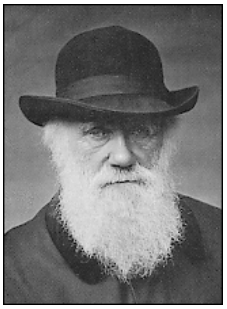
b. Leads to ideas that make sense under a ***variety*** of circumstances.

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. FALSIFABILITY

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

Components of the Scientific Process

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

Imagine Yourself in Mexico…

You order "soup"…

Components of the Scientific Process

1. Observation
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