

Sex in Space: Astronomy 330



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Office Hours:
W: 11:00 a.m. – noon
or by appointment

HW1 and 2 due Feb 1st
(on Compass)

Music: *We got the Neutron Bomb*– The Weirdos

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Outline



- Pseudoscience vs. real science?
- Pseudoscience is very common in ET life, i.e. UFOs, crop circles, etc.
- Need to be able to identify the two for presentations.

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Science



We especially need imagination in science. It is not all mathematics, nor all logic, but is somewhat beauty and poetry.

Maria Mitchell (1818 – 1889)
Astronomer and first woman
elected to American Academy of
Arts & Sciences

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Scientific Thinking



- It is a natural part of human behavior.
- We draw conclusions based on our experiences.
- Progress is made through “trial and error.”

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The Scientific Method



1. Make Observation
2. Ask a question
3. Suggest a Hypothesis
– a tentative explanation
4. Make a prediction
5. Test
6. What are the results?
– confirm, reject, or modify

These should be the same no matter who conducts the test

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Hallmarks of Good Science



- Science seeks explanations for *observed* phenomena that rely solely on natural causes.
- Science progresses through the creation and testing of models of nature that explain the observations as simply as possible.
→ Occam's Razor

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Occam's Razor



- *Pluralitas non est ponenda sine necessitate* [Latin]
- Given two equally predictive theories, choose the simpler.

Or

- *The simplest explanation is usually the best.*

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Hallmarks of Good Science



- Science seeks explanations for *observed* phenomena that rely solely on natural causes.
- Science progresses through the creation and testing of models of nature that explain the observations as simply as possible.
→ Occam's Razor
- A scientific model must make testable predictions that could force us to revise or abandon the model.

Theory - a model that survives repeated testing

Very different usage than everyday speech!

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Bad Scientific Practice



- **Pseudoscience** – masquerades as science, but does not follow the scientific rules of evidence
- **Not science** – establish “truths” through belief

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Hallmarks of Pseudoscience



1. **Use of vague, exaggerated or untestable claims**
 - Misuse of apparently technical jargon to give claims the superficial trappings of science.
 - Failure to give details of experiments, so they can be repeated.
 - No controls.

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Adapted from wikipedia

Hallmarks of Pseudoscience



2. **Over-reliance on confirmation rather than refutation**

- Over-reliance on testimonial, anecdotal evidence or personal experience.
- Presents data that seems to support its claims while suppressing or refusing to consider data that conflict with its claims.
- Reversed burden of proof. In science, the burden of proof rests on those making a claim, not on the critic.
- Assertion that claims that have not been proven false must be true, and vice versa.

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Adapted from wikipedia

Hallmarks of Pseudoscience



3. **Lack of openness to testing by other experts**

- Evasion of peer review before publicizing results. (typically they state that the peers are biased against the claims)
- Assertion of claims of secrecy or proprietary knowledge in response to requests for review of data or methodology.
- Requests money to see evidence

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Adapted from wikipedia

Hallmarks of Pseudoscience



4. Personalization of issues

- Tight social groups can enhance the adoption of beliefs that have no rational basis. In attempting to confirm their beliefs, the group tends to identify their critics as enemies.
- Assertion of claims of a conspiracy on the part of the scientific community to suppress the results.
- Attacking the motives or character of anyone who questions the claims.

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Adapted from wikipedia

Hallmarks of Pseudoscience



5. Use of misleading language

- Creating scientific-sounding terms in order to add weight to claims and persuade non-experts to believe statements that may be false or meaningless.
- Using established terms in idiosyncratic ways, thereby demonstrating unfamiliarity with mainstream work in the discipline.

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Adapted from wikipedia

Compare/Contrast



Science

Findings are expressed primarily through scientific journals that are peer-reviewed and maintain rigorous standards for honesty and accuracy.

Reproducible results are demanded; experiments must be precisely described so that they can be duplicated exactly or improved upon.

Failures are searched for and studied closely, because incorrect theories can often make correct predictions by accident, but no correct theory will make incorrect predictions.

As time goes on, more and more is learned about the physical processes under study.

Convinces by appeal to the evidence, by arguments based upon logical and/or mathematical reasoning, by making the best case the data permit. When new evidence contradicts old ideas, they are abandoned.

Does not advocate or market unproven practices or products.

Pseudoscience

The literature is aimed at the general public. There is no review, no standards, no pre-publication verification, no demand for accuracy and precision.

Results cannot be reproduced or verified. Studies, if any, are always so vaguely described that one can't figure out what was done or how it was done.

Failures are ignored, excused, hidden, lied about, discounted, explained away, rationalized, forgotten, avoided at all costs.

No physical phenomena or processes are ever found or studied. No progress is made; nothing concrete is learned.

Convinces by appeal to faith and belief. Pseudoscience has a strong quasi-religious element: it tries to convert, not to convince. You are to believe in spite of the facts, not because of them. The original idea is never abandoned, whatever the evidence.

Generally earns some or all of his living by selling questionable products (such as books, courses, and dietary supplements) and/or pseudoscientific services (such as horoscopes, character readings, spirit messages, and predictions).

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Adapted from <http://maxwell.unc.edu/mcorwin/Powerpoint/Distinguishing%20Science%20and%20Pseudoscience.htm>

Example



<http://www.stopabductions.com/>

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Groups



- In groups of more than 3 and less than 5, discuss pseudoscience compared to science.
- Write a pseudoscience argument for something that one might find on a webpage pertaining to topics of this class (no more than 1 page).
 - One sheet for the group.