

Astronomy and Astrology or What is science?

February 14th

Topics today

- What is science?
- Hypothesis, model, and theory
- Logical deduction
- Quantitative and testable predictions
- Falsifiability
- Which theory is better?
- The experiment: astrology

What is science?

The history of astronomy is
a history of science.

So what is science?

or

how does science work?

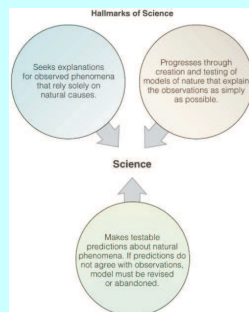
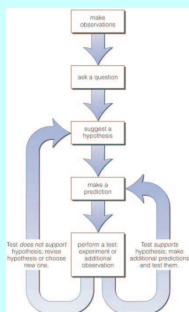
Hypothesis, model, and theory

Hypothesis: an idea, tentative explanation
can be tested with experiments!

Model: a simple logical construct, that explains
observed behavior
allows testable predictions

Theory: a time-tested model, whose
predictions have been verified

Hypothesis, model, and theory



Logical deduction

Deductive logic:

- 1) All even numbers can be divided by 2
 - 2) 8 is an even number
- 8 can be divided by 2

If proved wrong, 1) or 2) must be wrong!

Inductive logic:

Mars, Venus, Jupiter, etc, are on the ecliptic
→ all planets are on the ecliptic

One counterexample proves you wrong!

Logical deduction

Absence of evidence

is not

evidence of absence.

I have never exceeded the speed limit!

I never received a ticket for speeding!

Trouble with inductive logic....

Be careful!

Quantitative, testable predictions

Combine models and deductive logic to make predictions:

Model: the gravitational force is pulling objects toward each other and falls off with increasing distance.

Prediction: the Moon pulls stronger at the facing side of Earth than at the far side. Can calculate difference in force.

Do we observe this?

Falsifiability

What if experiments showed, the force on the front and back side of Earth were the same?

→ check and repeat your experiment

→ conduct independent experiment

If all agree, you have **falsified** the model.

→ modify your model

Nothing is holy in the old model,
but small changes may suffice

Which model is better?

Among competing successful models
prefer the simpler one (Occam's razor).

Worked against Copernicus for a while

Natural causes:

systematic behavior described by laws.

Divine intervention is complicated

The experiment: astrology

Hypothesis:

a horoscope predicts your fortunes for the day

Experiment:

- 1) Find your zodiac sign
- 2) Select best-fitting horoscope for yesterday
- 3) Compare with chance expectation:
Null-hypothesis: 12 signs, chance 1/12

The experiment: astrology

Mar 21 – Apr 20	Aries
Apr 21 – May 22	Taurus
May 23 – Jun 23	Gemini
Jun 24 – Jul 23	Cancer
Jul 24 – Aug 23	Leo
Aug 24 – Sep 22	Virgo
Sep 23 – Oct 23	Libra
Oct 24 – Nov 22	Scorpius
Nov 23 – Dec 21	Sagittarius
Dec 22 – Jan 19	Capricorn
Jan 20 – Feb 18	Aquarius
Feb 19 – Mar 20	Pisces