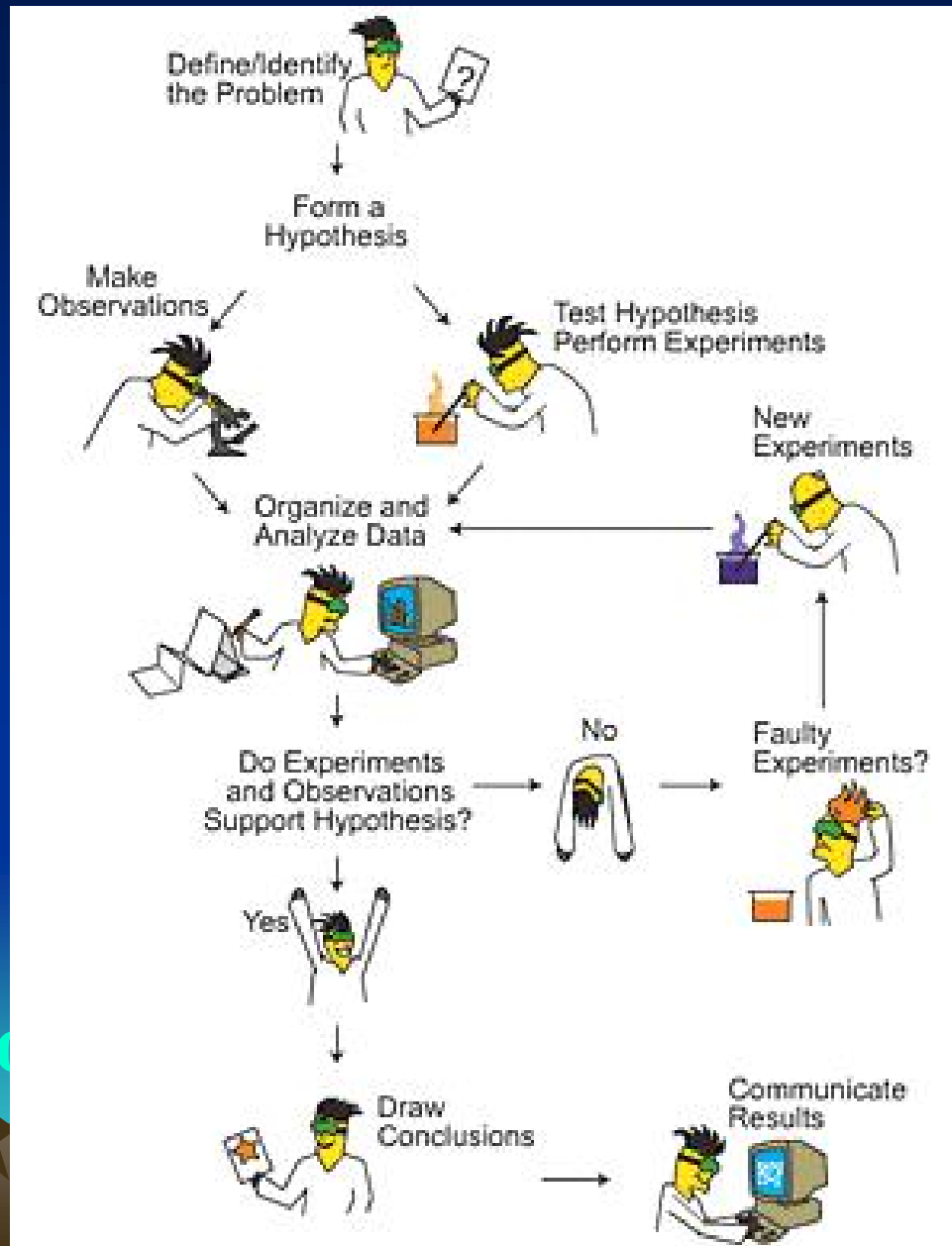
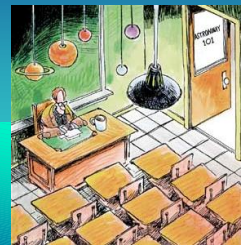


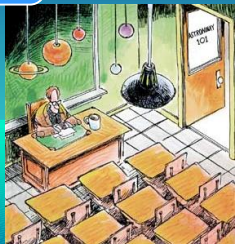
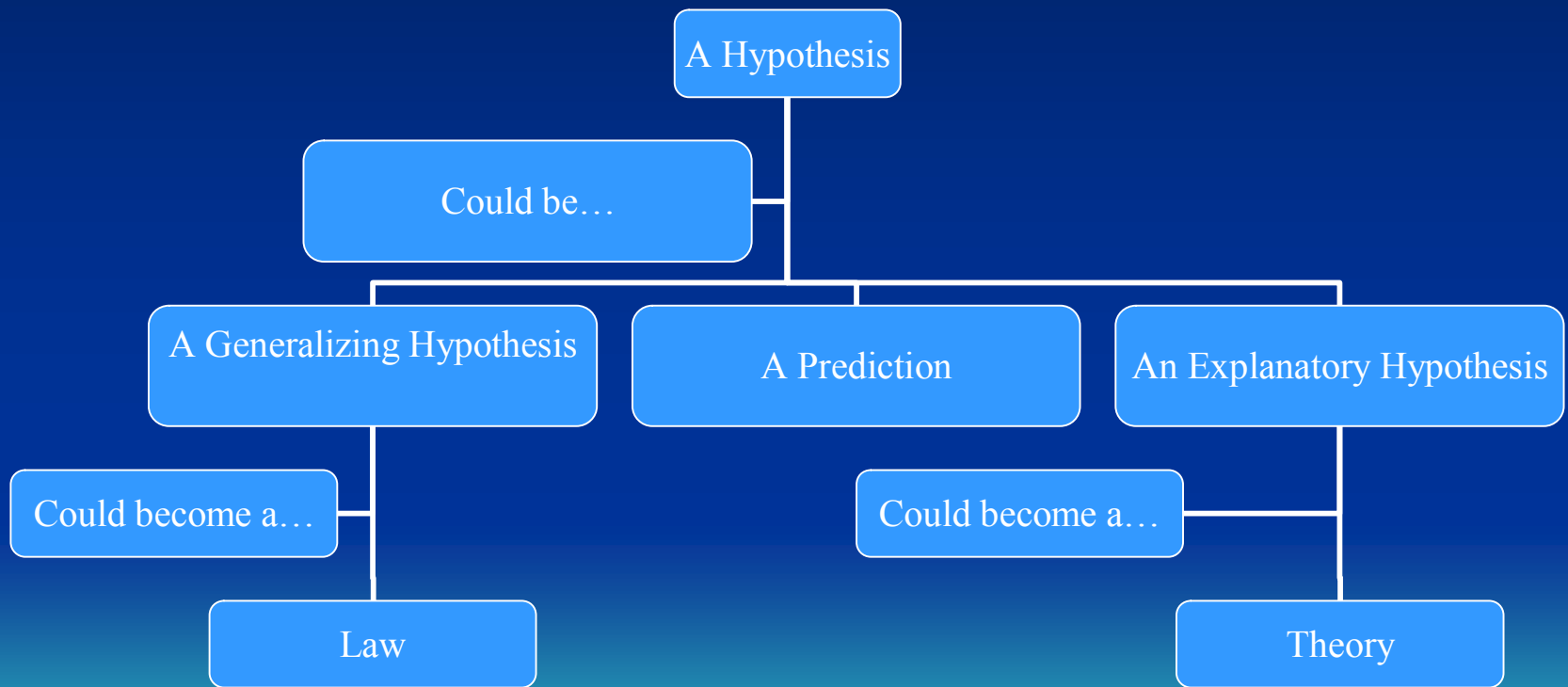
The Scientific Method



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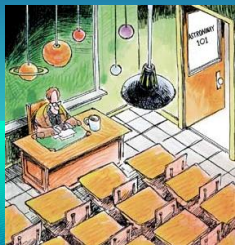


Hypothesis, Theory, and Law



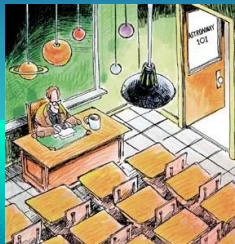
Goal

- What are the different types of hypothesis?
- What is the difference between hypothesis/theory/law?
- What is the scientific method?
- Does the scientific method work?
- What is not a scientific argument?



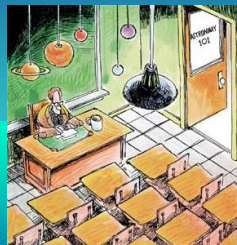
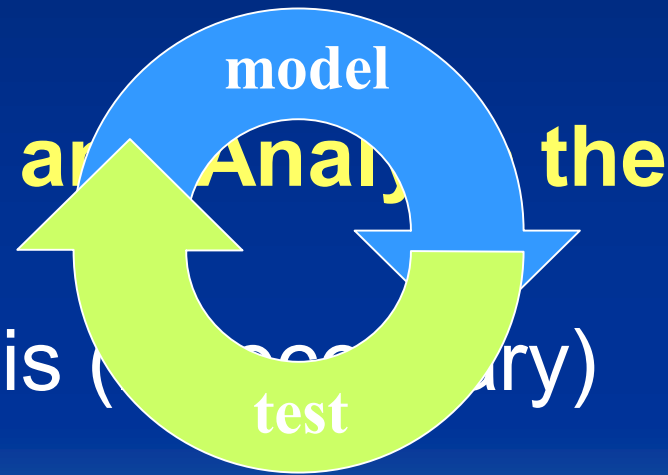
What is science?

- Science is a tool.
- Science is the study of natural phenomenon
- Medicine: “I have high cholesterol, what should I do?”
 - Take cholesterol lowering medication.
 - Consult your astrologer.
 - Pray to the god Baal and sacrifice a goat.



The Scientific Method

1. **Ask a Question**/Define Problem
2. Develop a **hypothesis (or model)** which makes a **prediction**. (If...then....)
3. **Test** the hypothesis.
4. **Make Observations and Analyze the Results.**
5. **Revise** the hypothesis (if necessary)
6. **Draw conclusions**
7. Communicate Results
8. A successful explanatory hypothesis becomes a **Scientific Theory**.



Medical Science

Scientific Method	High Cholesterol
Observation	Patient has high cholesterol
Hypothesis (prediction)	Certain chemicals may dissolve cholesterol deposits.
Test	Give 100 patients these chemicals, give 100 patients placebo.
Observe result	Same number lower their cholesterol as placebo patients.
Revise hypothesis?	Try different combo of chemicals.
New test?	Re-run medical test. Observe results.
Scientific Theory	Lipitor reduces cholesterol.



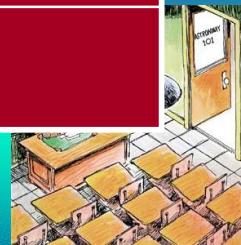
Everyday Science

Scientific Method	Car Repair
Observation	Engine won't turn over.
Hypothesis (prediction)	Predict battery is dead.
Test	Replace battery.
Observe result	Engine now turns over.
Revise hypothesis?	Not needed.
New test?	Not needed.
Scientific Theory	Cars won't work without a fully charged battery.



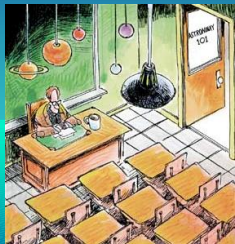
Everyday Science

Scientific Method	Making Spaghetti Sauce
Observation	Spaghetti sauce should be red.
Hypothesis (prediction)	Try a tomato sauce.
Test	Heat pot of tomato sauce.
Observe result	Taste the sauce - bland.
Revise hypothesis?	Use tomato sauce and garlic!
New test?	Add garlic, taste - not so bland.
Scientific Theory	The Final Recipe.



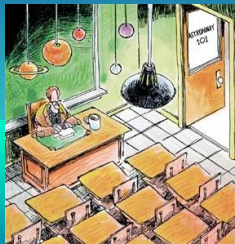
Repeatability

- A successful theory is repeatable.
 - By you.
 - By anyone.
- Examples:
 - Cold Fusion (1989)
 - Theory of Relativity



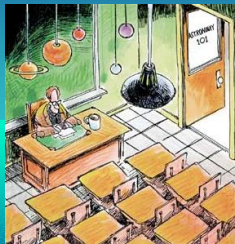
Requirements

- Objective reality
 - We all see the same world.
- Constant Laws of Nature
 - What happens here, happens there.
 - What happened yesterday will happen tomorrow



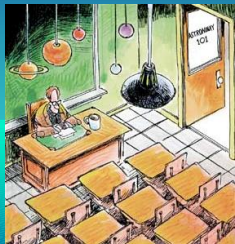
Does it work?

- Scientific Method is a tool
- Is this the “only” scientific method?
 - Imagination, creativity, prior knowledge, and perserverance
- Does this tool work?
- Are there better tools?



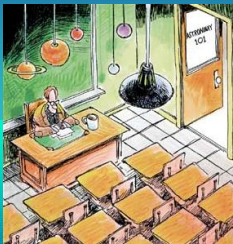
Recap: Theories, Guesses, Laws

- What does the word Hypothesis mean?
- What does the word “Theory” mean to you?
 - “A conjecture; guess” (Webster’s Dictionary)
- Does it mean the same to a scientist?
 - “A model which has been born out by repeated tests and observation.”
- Is a Theory less than a Law?
 - “Evolution is just a theory, it is not a fact.”
- Do Theories “grow up” to be Laws?
 - “Einstein’s Theory of Relativity”



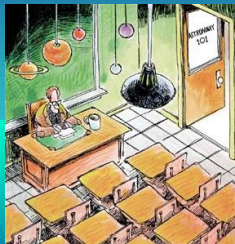
Non-scientific Hypothesis/Theory

- **Make no predictions**
- **Un-testable**



Non-scientific Theories

- Car won't work? → Aliens drained the battery.
- Spaghetti is bland? → You were meant to eat bland food.
- Car won't work? → Gods must be angry.
- Spaghetti is bland? → At the instant of tasting, tongue is transported to alternate dimension where all flavors are rendered nullified. Happens instantaneously.



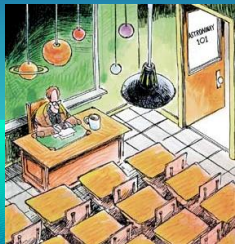
Non-scientific Theories



Viking Orbiter (1976)

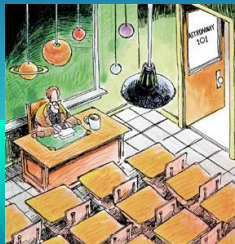


Mars Global Surveyor (1998)

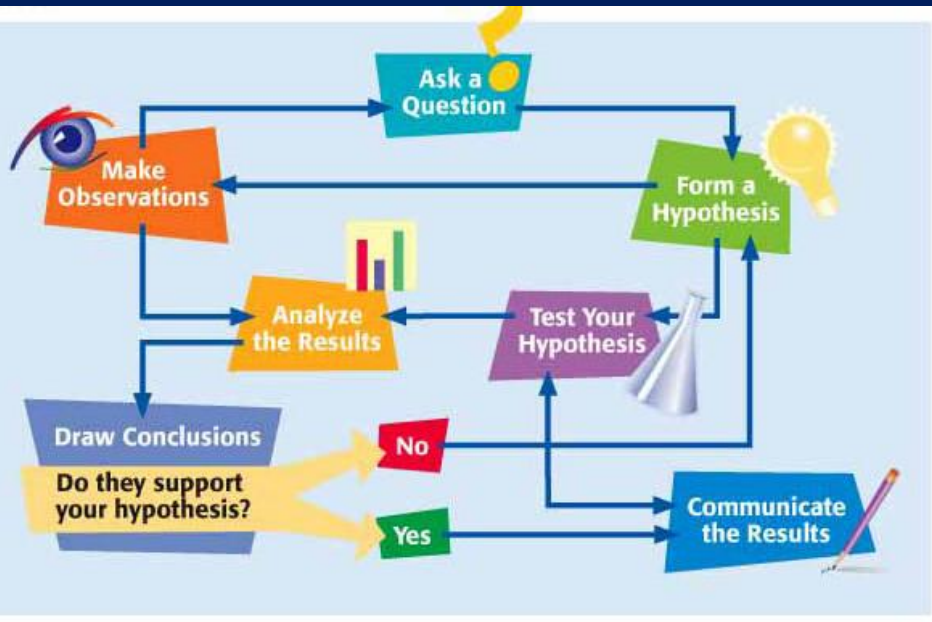


Falsification

- A real Scientific Theory tells you what observations are necessary to falsify it.
 - Not so proponents of:
 - Face on Mars
 - Moon Hoax
 - Intelligent Design
 - Astrologers



Scientific Method Investigation



- Follow the scientific method to perform mission impossible.
 - Record the steps in your science notebook
 - Remember to follow the steps of the scientific method:
- Due Day One of Next Week!

