What is Science?
“In the space of one hundred and seventy-six years the Lower Mississippi has shortened itself two hundred and forty-two miles. That is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Silurian Period, just a million years ago next November, the Lower Mississippi River was upwards of one million three hundred thousand miles long, and stuck out over the Gulf of Mexico like a fishing rod. And by the same token any person can see that seven hundred and forty-two years from now the Lower Mississippi will be only a mile and three quarters long, and Cairo and New Orleans will have joined their streets together, and be plodding comfortably along under a single mayor and a mutual board of aldermen.

There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact.”

from *Life on the Mississippi*, by Mark Twain
Question Authority
Question Authority
They Don’t Know Either
What Science Is

Science is a process by which we investigate our world.

– Science is not a litany of facts.
– Science employs the technique of objective materialism. *This means that science is limited to seeking natural laws and processes to explain the world.*
Thales (c. 600 BCE) is considered the first scientist.

He postulated that

there must be an underlying order to the universe, subject to rational inquiry, accessible by observation
What Science Is Not

Science is not

• Dogmatic
• Authoritative
• Mysterious

Supernatural explanations are not science.
What Science Is

Scientific explanations must be

- **Testable**, and
- **Falsifiable**

- Science is **self-correcting**
• Knowledge is cumulative

• Science is an evolving process.

• We recognize that we do not know everything, but that we are learning.

• As we learn, facts or observations that we cannot now explain may become explicable.
Definitions

• **Fact**: what we observe.

• **Law**: a descriptive generalization of facts, such as the law of gravity.

• **Theory**: An explanation for the laws and facts.
  – Must have predictive power
  – The theory is the pinnacle of science.
Ohio lawmakers want to limit the teaching of the scientific process
Sponsor endorses ID, wants to bar "political... interpretation of scientific facts."

Science educators have recognized that teaching science as a large compendium of facts, without reference to the scientific process and theories that bind them together, simply leads to uninterested and uninformed students. So it's a bit mind-boggling to discover that an Ohio state legislator is attempting to block educators from teaching anything about the scientific process. And for good measure, the bill's sponsor threw politics and creationism into the mix.

The bill, currently under consideration by the Ohio Assembly, is intended to revoke a previous approval of the Common Core educational standards, which target math and literacy. However, the bill's language also includes sections devoted to science and social studies. And the science one is a real winner:

Specifically prohibiting a discussion of the scientific process is a recipe for educational chaos. To begin with, it leaves the knowledge the kids will still receive—the things we have learned through science—completely unmoored from any indication of how that knowledge was generated or whether it's likely to be reliable. The scientific process is also useful in that it can help people understand the world around them and the information they're bombarded with; it can also help people assess the reliability...
A Rube Goldberg Device

THE PROFESSOR emergs FROM THE GOOFY BOOTH WITH A DEVICE FOR THE EXTERMINATION OF MOTHS.

START SINGING. LADY UPSTAIRS, WHEN SUFFICIENTLY ANNOYED, THROWS FLOWER POT(A) THROUGH AWNING(B). HOLE(C) ALLOWS SUN TO COME THROUGH AND MELT CAKE OF ICE(D). WATER DIPS INTO PAN(E) RUNNING THROUGH PIPE(F) INTO PAIL(G). WEIGHT OF PAIL CAUSES CORD(H) TO RELEASE HOOK(I) AND ALLOW ARROW(J) TO SHOOT INTO TIRE(K). ESCAPING AIR BLOWS AGAINST TOY SAILBOAT(L) DRIVING IT AGAINST LEVER(M) AND CAUSING BALL TO ROLL INTO SPOON(N) AND PULL STRING(O) WHICH SETS OFF MACHINE GUN(P) DISCHARGING CAMPHOR BALLS(Q). REPORT OF GUN FRIGHTENS LAMB(R) WHICH RUNS AND PULLS CORD(S) OPENING CLOSET DOOR(T) AS MOTHS(U) FLY OUT TO EAT WOOL FROM LAMB’S BACK THEY ARE KILLED BY THE BARRAGE OF MOTHS BALLS.

IF ANY OF THE MOTHS ESCAPE AND THERE IS DANGER OF THEIR RETURNING, YOU CAN FOOL THEM BY MOVING.
Occam’s Razor

- Pluralitas non est ponenda sine neccesitate (William of Occam) (Entities should not be multiplied unnecessarily)
- Nature operates in the shortest way possible (Aristotle)
- We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances (I. Newton)
- Everything should be made as simple as possible, but not simpler (A. Einstein)
- If two theories explain the data equally well, the simpler theory is generally preferable

Or: Never attribute to malice that which can be attributed to stupidity

The KISS principle: Keep it simple, stupid!
The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'eureka!' but 'that's funny...'

- Isaac Asimov