# WRITING ABOUT SCIENCE FOR NON-SCIENTISTS
## Art Hobson, U Arkansas

# OUTLINE

- Bio
- Why we should communicate with the public

ADVICE:

- Keep it non-technical
- Keep it relevant
- Focus around one or more themes
- Write good sentences

# Bio

- Music degree 1955 (jazz trombone)

- Started over in physics 1958, PhD 1964.

- U Arkansas: Theorist 1964-1975.

- Then education, societal topics, 4 books.

- Physics: Concepts & Connections (4/e 2006).

  - Science literacy, for college non-science students.

  - Major undertaking, only for the committed.
  physics.uark.edu/hobson/

- Bi-weekly column in hometown paper.

  - Easy, rewarding:  try it!

  - My articles are at
  physics.uark.edu/hobson/
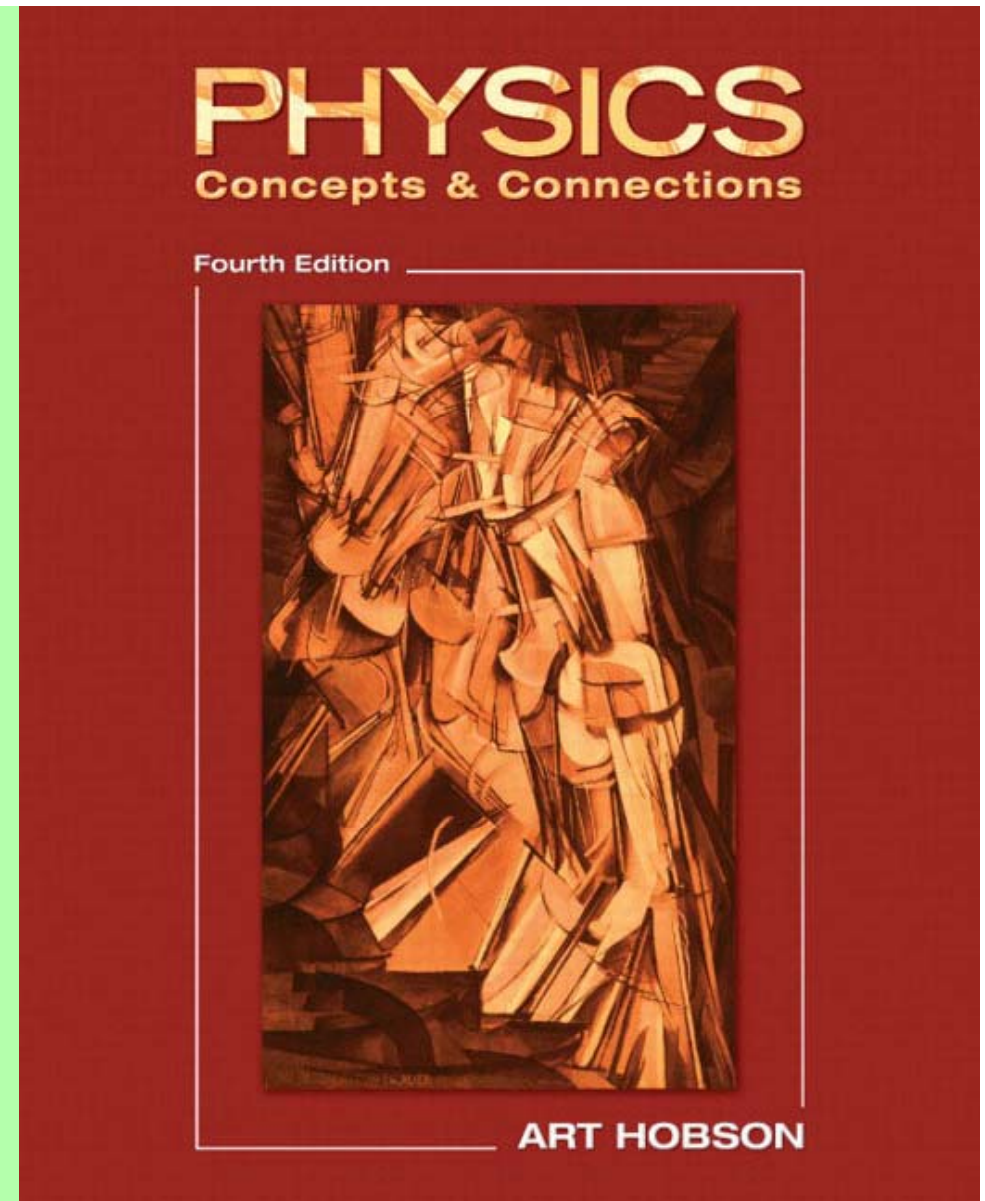
# Scientists should communicate more & better with non-scientists

- Non-scientists--our future legislators, parents, teachers, journalists, presidents!
- Misplaced priorities (research, physics students)

# Carl Sagan, 1995:

"We've arranged a global civilization in which most crucial elements …profoundly depend on science and technology.

We have also arranged things so that almost no one understands science and technology.  This is a prescription for disaster.  We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces."
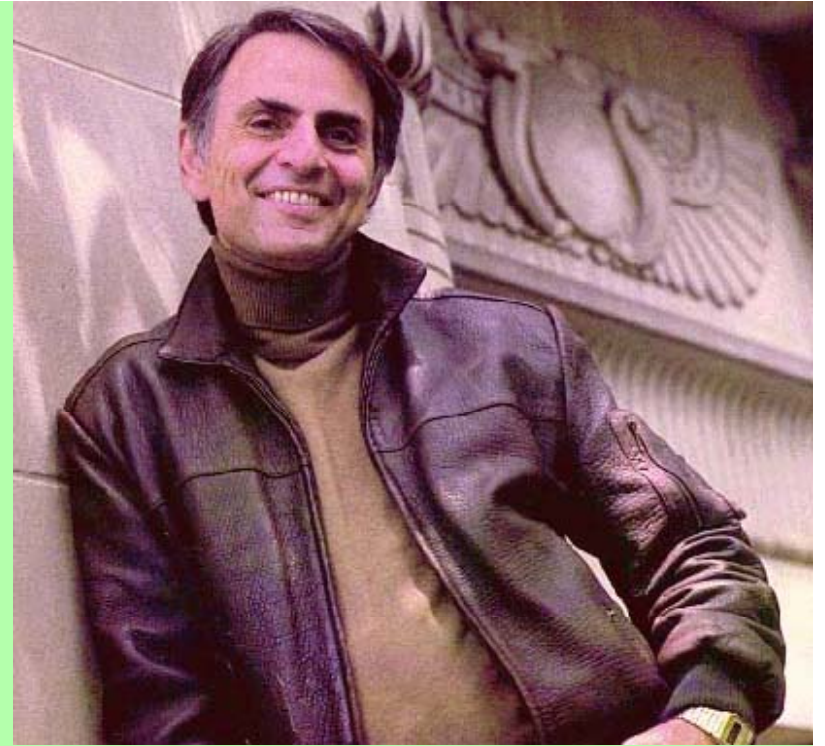
# AAAS, Project 2061, Science for All Americans:

"The life-enhancing potential of science and technology cannot be realized unless the public in general comes to understand science, mathematics, and technology and to acquire scientific habits of mind; _without a scientifically literate population, the outlook for a better world is not promising._ …[But] most Americans are not scientifically literate. …The United States should be able to do better."   [My emphasis].

# Advice about writing

# Keep it non-technical, focus on concepts

- Non-scientists have no need for equations; they only create disinterest and fear.

- Use only <u>needed</u> technical words; explain the idea before introducing the word.

- Use plenty of numbers, but explain powers of ten, probabilities, etc. if you use them.

- Proportionalities can be useful.

- Briefly:  Be "numerate" but not "algebraic."

# Be relevant to non-scientists' interests

- Depends on audience, but I find plenty of interest in <u>modern</u> topics, and <u>societal</u> topics.

# A few modern topics:

- Relativity of time and space
- Energy has mass and vice-versa
- General relativity, curved space
- Creation & evolution of universe
- Quantum uncertainty
- Quantum entanglement
- Quantum fields
- Quarks, neutrinos, what is an electron
- The string hypothesis

# A few societal topics

- Atm ozone depletion, and solutions
- Global warming, and solutions
- Nuclear weapons, and solutions
- Nuclear power
- The energy crisis, and solutions
- The ages of the universe, Earth, fossils
- Transportation technology (fuel cells etc)
- The search for extra-terrestrial intelligence
- The scientific process; how do we know?
- Pseudoscience (e.g. creationism)

# A few newspaper column titles

All columns are at physics.uark.edu/hobson/

- Are we scientifically literate?

- In praise of reason

- Coal & our energy future

- Whither Fayetteville High School?

- Arkansas energy resources: lignite

- The real cost of gasoline

- Winning the climate race

- The LHC: going boldly where none have gone

- Let's talk about religion

- Transportation and cowboy mythology

- The search for Earth-like planets

# Focus around one or more story lines

- My textbook has 4 story lines:

1. The scientific process: how do we know?

2. What's different about modern physics?

3. Energy

4. The social context of physics

- These re-appear throughout the book.

- Central physics topic, "energy," doesn't appear until Chps 6 & 7. So I began writing with these chps, and worked forward & backward.

# Write good sentences

- Read each paragraph slowly, listening.

  --Graceful, or clumsy?

  --Honest, or pretentious?

  --Concise, or wordy?

- Take time to find the right words.

- Revise revise revise

- Keep the struggling reader foremost in mind!

- Don't beat around the bush.

- Break up complex sentences.

- Be wary of all modifiers (adjectives & adverbs).

- Shorter is nearly always better.

# Two good books:

1.  Strunk & White, "The Elements of Style"

    --timeless classic of good writing.


2.  Michael Alley, "The Craft of Scientific Writing"

    --full of examples of what to do and not do.

Their advice can be summarized as:


**AVOID FLABBY PROSE.**


Let's discuss some of the specifics:

# Use active voice

- Passive:  Mass spectroscopy was used to determine the position of the atoms.

- Active: Mass spectroscopy determined the position of the atoms.

# Use strong, specific verbs, not forms of "to be"

Weak                                    Strong

is used to detect                       detects

was beginning                           began

is capable of                           can

# It's OK to use "I"

Michael Alley: "Much passive voice arises in scientific writing because scientists cling to the misconception that they can't use the first person ('I' or 'we'). But Einstein, Feynman, Darwin, and many others used the first person."

- So don't use phrases such as "It was determined that…"

# Less is more

| Pretentious | Simple equivalent |
|---|---|
| activate | start |
| initialize | start |
| consequently | so |
| contiguous | adjacent |
| subsequently | then |

# Eliminate "writing zeroes" that provide no information

- It is interesting to note that ….
- As a matter of fact ….
- I might add ….
- The fact that ….

# Cut the fat

Saves the reader's time and saves paper; much more importantly, it invigorates your writing.

- Full of fat:  "Following the observance of this occurrence, it was determined …"
- Fat-free:  "We then determined …"

# Don't make nouns out of your verbs

wrong                           right

perform a study                 study

add heat to the system          heat the system

make measurements of            measure

# Eliminate redundancies

Omit the words in parentheses:

- (already) existing
- (alternative) choices
- at (the) present (time)
- (first) began
- start (out)

# I'll leave you with advice from



Winston Churchill:

"Short words are the best and old words when short are the best of all."



And Ernest Hemingway:

"Cut the bullshit."