

# ALL I REALLY NEED TO KNOW . . .

David P. Stern

Recently I picked up a paperback that was lying around the house, *All I Really Need to Know I Learned in Kindergarten*, a collection of short essays by Robert Fulghum. Years ago when it topped the best seller list, it somehow passed me by (but not my wife, who must have brought it home).

The first essay in the book stated Fulghum's personal credo—what he really needed to know, he claimed to have learned in kindergarten.

What is a physicist's credo? What things does a physicist need to know? I thought it over and compiled a list, and here it is. Your priorities might differ—this is the list of a theorist concerned with research. None of the items listed was learned in kindergarten; in fact, none was part of my university or graduate curriculum. It turns out that all I really need to know about physics I had to dig up by myself.

## A physicist's credo

Keep notes of ideas, lectures and work. Memory fades but what is written down stays yours. While young you may wing it, but once you turn 40 or 50, your notes—numbered, dated, indexed and collected in binders—make all the difference between still doing useful work and spinning your wheels.

Rough notes are but a fading latent image. Transcribe them, don't wait. Edit what you produce, illustrate it, use neat handwriting or, better still, use a word processor. The material is hard enough; whatever smoothes its retrieval is a great help.

If it's memorable, write it down. Keep an open notebook by the phone. Number and date your entries.

Scan the literature and read what

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is pertinent. (You aren't Feynman.) Collect references. Be lucid and even tutorial in writing your own papers.

Take time to select the text you study. A poor text will frustrate you, a good one will make you soar. Seek one that provides intuitive insights and write down in your own words key sections and calculations. Solve problems.

Never stop studying. Make up your own exercises as you go along. They prepare the way for more serious problems.

Don't get drawn into a big project unless you have a clear idea of its final product.

Go for the big problems. No one cares about publishable petty results.

Take your time preparing for a project—or else you may spend too much time doing things you did not need to do.

Look out for the future. Make a program of what you intend to do—next month, next year, in the long term. Adjust it as you learn more.

Learn to smell out good problems. Skill in finding them is more important than skill in solving them (though both count). You have it made if you know how to transform puzzling data into well-posed problems. Stash away partially solved puzzles for later attention.

Never tell yourself you understand when you don't. (How can you know the meaning of  $F = ma$  unless you clearly define  $F$  and  $m$ ?) And if you don't understand, struggle to do so. Consult books, friends and common sense. Keep notes.

If in the end you still don't get it, write down what you have. Some day you might be able to continue.

Take the time to arrange ideas in your mind and notes: The pattern is just as important as the material. Awareness of history helps one recognize the pattern.

Don't fear drudgery. No pain, no

gain.

However, if a piece of calculation leads into an ever-denser thicket, nature probably did not intend you to go that way. Look for a different approach.

Once you understand a derivation, try to divine its intuitive meaning. Ideally, all you need remember are concepts; the math can be added later.

Check dimensions and orders of magnitude.

Prepare for every lecture. In writing.

Rehearse ten-minute talks for meetings. Distribute preprints.

Answer mail.

If you head a committee, take time to clarify to yourself what it should produce. Write down your own agenda before each meeting. Keep your own minutes, and keep the committee alive between meetings.

You learn a lot from writing a review article. A thorough job may make you a foremost expert in whatever the review describes. Also, in the process you are likely to uncover one or two good research ideas worth pursuing.

Give fair credit.

Find a mentor if you can, but don't be surprised if you can't. Good mentors are rare, and everyone is busy. Perhaps you can fill the role for someone else.

Collect bright young people.

Talk to colleagues. Cherish the few who are really interested in your work.

Take time to ask the experts. They don't mind and may actually be pleased to display their erudition.

Look for kindred souls. They are few and far between, and nothing is more precious.

Being a physicist is a great privilege. Be worthy of it. Most of humanity spends its life doing boring repetitive tasks. ■