some clear positions. For example, it suggests roughly doubling average fiber intake, to 38 grams per day for men and 25 grams for women.

Certain recommendations—such as urging every adult to get an hour's daily exercise, twice the amount recommended in the past—seem to ignore the real-life lifestyles of North Americans. "I couldn't possibly do an hour of exercise a day," says Marion Nestle, chair of the department of nutrition and food studies at New York University. Nestle, who was not on the panel, complains that the report is too complex for "an already confused public." What causes obesity "isn't rocket science … eating too much [does]."

Indeed, panel member Ronald Krauss, who studies diet and heart disease at Lawrence Berkeley National Laboratory in California, agrees that the report might not respond to the question people generally ask: "How much of this should I eat?" Unfortunately, science isn't able to deliver such detailed diet advice quite yet.

–JENNIFER COUZIN

UNDERGRADUATE SCIENCE

Biology Departments Urged to Bone Up

In 1998, Sheldon Wettack, a dean at Harvey Mudd College in Claremont, California, decided that undergraduates needed a better appreciation of the connections between biology and the physical sciences. He and a few faculty members devised a program, called the Interdisciplinary Laboratory, that parallels intro chemistry and physics classes and includes such exercises as how thermodynamics affects animal design. Wettack hoped that the new team-taught lab would strengthen the biology curriculum and maybe even attract majors from the more quantitative sciences into biology.

This kind of approach is exactly what's needed to train the next generation of biomedical researchers, says a new report by the National Research Council (NRC).* "Biological research is already highly interdisciplinary, but undergraduate education is not," says panel chair Lubert Stryer of Stanford University in Palo Alto, California. "And the gap is increasing."

The NRC panel, funded by the National Institutes of Health and the Howard Hughes Medical Institute (HHMI), found that undergraduate biology education also needs a more rigorous curriculum. Many of the recommended changes are longtime favorites of science education reformers (*Science*, 31 August 2001, p. 1607), including thought-provoking lab exercises and independent research projects. To improve quantitative skills, faculty members should include more concepts from math and physical sciences in biology classes. Ideally, the report says, the entire curriculum would be revamped to add more heft.

But these changes face many obstacles, including the expense of developing new course materials and the conservative influence of the Medical College Admission Test (MCAT), a national qualifying exam for would-be U.S. medical students. "It is time that the curriculum started driving the MCAT, not the other way around," says David Hillis of the University of Texas, Austin. When it comes to curricula, there is also a massive amount of inertia in higher education, says Peter Bruns, vice president for grants and special programs at HHMI. "People say the only institution more conservative is the [Catholic] Church."

Even when reform is on the agenda, it's hard for departments to agree on how to carry it out. "If you add something, you have to take something away," says Hillis, and no one wants his or her subject trimmed. Personal foibles can play a role, too: A professor who agrees that number-crunching skills would be useful might still be loath to admit ignorance. "Most faculty have trouble saying, 'I don't know much about this topic, but you should,' " says chemist Ronald Breslow of Columbia University in New York City.

Now hear this. New report emphasizes hands-on activities over lectures for undergraduates.

CREDIT: PATRICK WARD/CORBIS

One way to achieve change is by sweetening the pot. Toward that end, next week HHMI will award $1 million over 4 years to each of 20 senior faculty members who have proposed ways to improve undergraduate biology education at their institutions. The idea is to provide role models as well as the necessary resources. That approach makes good sense to Stryer, who says that energetic leadership is a key ingredient in making the panel's recommendations a reality.

–ERIK STOKSTAD

* *BIO2010: Undergraduate Education to Prepare Biomedical Research Scientists* (National Academy Press, 2002).

INFORMATICS

The Genome Chose Its Alphabet With Care

Of all the nucleotide bases available, why did nature pick the four we know as A, T, G, and C for the genomic alphabet? Researchers have long put it down to the composition of the primordial soup in which the first life arose. But Dónall Mac Dónaill of Trinity College Dublin says the answer is much more interesting. He believes that the choice of A, T, G, and C incorporates a tactic for minimizing the occurrence of errors in the pairing of bases, in the same way that error-coding systems are incorporated into ISBNs on books, credit card numbers, bank accounts, and airline tickets. "The answer may lie partly in the error-coding aspects of information transfer," he says.

There are 16 possible nucleotide bases that could pair up to make DNA, and researchers have created strands of synthetic DNA using all the combinations. Informatics might be the key to why nature ignored all but four of these possibilities, Mac Dónaill suspected, and he built on the structural work of biologist Eörs Szathmáry of the Collegium Budapest in Hungary to test his hunch.

In the error-coding theory first developed in 1950 by Bell Telephone Laboratories researcher Richard Hamming, a so-called parity bit is added to the end of digital numbers to make the digits add up to an even number. For example, when transmitting the number 100110, you would add an extra 1 onto the end (100110,1), and the number 100001 would have a zero added (100001,0). The most likely transmission error is a single digit changed from 1 to 0 or vice versa. Such a change would cause the sum of the digits to be odd, and the recipient of that number can assume that it was incorrectly transmitted.

Mac Dónaill asserts, in a forthcoming issue of *Chemical Communications*, that a similar process was at work in the choice of bases in the genetic alphabet. First he represented each nucleotide as a four-digit binary number. The first three digits represent the