not all) are not ready to do the rigorous version in the first year they take calculus. A reality one of us (D.J.L.) notes is that current calculus students are much different from those of 25 years ago. The reform calculus methods work to address this new constituency more so than the potential math, physics, and engineering majors, who often place out of first-year collegiate calculus. It is hoped that future reform efforts will also increase the focus on these advanced placement students. The quote "losing math majors left and right" (attributed to D.J.L. in the Random Samples item) referred to the possible consequence of *not* doing so.

Although the three of us have varied types of involvement in the calculus reform movement, we all agree that there are many issues to be considered in the successful education of undergraduate mathematics students. It is therefore important for the mathematics community to work together to better understand the impact of various teaching methods. Studies such as that done at the National Science Foundation (by S.L.G.) are designed to further improve the undergraduate curriculum. The full report on this work, which will be widely distributed upon completion later this year, will include information on student performance and attitudes, faculty reactions, retention, and other areas of impact. We hope that mathematicians and other educators will use it as a resource for further discussions about curricular excellence in undergraduate mathematics education.

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Math and Science Literacy

I am confused by the article "Northern Europe tops in high school" by Gretchen Vogel (News, 27 Feb., p. 1297). I don't understand the table "Mathematics and science literacy." Why is Austria, with a mean score of 519 in the "significantly above" group, while Australia, with a mean score of 525, is in the "average" group? Hungary, with a score of 477, and the Russian Federation, with a score of 476, are both in the "significantly below" group, while the Czech Republic, with a score of 476, is in the "average" group. Also, I don't understand the amusement ride question (if A is correct, why?).

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Response: The Third International Mathematics and Science Study report included Australia and the Czech Republic in the "average" group because their raw scores had relatively large statistical error bars. Their scores are not significantly different from those of countries in the international average group. The correct answer to the example problem is A. The arrow pointing down represents gravity, the arrow pointing up represents the force of friction due to the "rough wall" described in the problem, and the arrow pointing toward the center of the circle represents the centripetal force exerted by the wall that keeps the rider moving in a circle. Readers who guessed wrong are in good company; only 20% of advanced physics students answered correctly.

Gretchen Vogel

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Fishery and Reef Management

Callum M. Roberts (Reports, 21 Nov., p. 1454) uses a model of reef connectivity to identify beneficial management partnerships and to evaluate marine reserves in integrated networks. The model is clear and compelling. But, like others based on similar approaches (*1*), it makes one simplifying assumption—that fish larvae are dispersed passively by currents. However, the available data do not support this assumption. All indications are that larval reef fishes actively influence their dispersal. Unlike many invertebrate larvae, reef-fish larvae are competent swimmers capable of high speeds and long endurance (*2*). Some reef-fish larvae can swim more than 100 kilometers in a single bout at speeds equal to those of ambient currents. Many taxa may be capable of overriding passive "transport envelopes," either to retard or enhance dispersal (*2*). Field observations suggest that larval reef fishes can detect and respond to the presence of reefs at night and over considerable distances in the day (*2*, *3*). They also exhibit a fine degree of control over the process of settlement and recruitment (*4*). We must establish a sound basis for evaluating connectivity between marine reserves. However, genetic connectivity data will not test Roberts's model: a few individuals a year will maintain genetic links, but will not maintain fisheries.

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Roberts uses "major surface current patterns" for the Caribbean region. Work in Barbados and elsewhere (*1*, *2*) demonstrates that current patterns are highly dynamic in speed and direction. General circulation patterns do not account for the spread of a pathogen that decimated populations of *Diadema antillarum* in the early 1980s (*3*). That pathogen travel led inexorably upstream throughout the Caribbean, arriving last at Barbados. Larvae of many taxa, including fishes, actively travel vertically, taking advantage of differential current speeds and directions at depth, even when they are otherwise subject to passive transport (*4*). The growing evidence that reef fish larvae, in particular, may actively determine their dispersal is far stronger than Roberts hints (*5*). The interaction of behavioral traits and local circulation can lead to retention of larvae around isolated islands such as Barbados and Bermuda (*1*, *6*); there is no reason to believe that such retention is less important at other downstream areas. Showing that larval exchange may be possible based on mean current patterns is a far cry from demonstrating that sufficient exchange occurs to sustain downstream populations.

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Response: The current patterns upon which I based my larval transport envelopes represent averages over long time scales. There will undoubtedly be much short-term variability over periods of days to months, but for management purposes, we need to take a longer-term view. Contrary to what Sale and Cowan say, my model does account for upstream transport. I noted that there are nearshore countercurrent flows along most coasts, and their effects are included in transport envelopes as upstream extensions. Such flows predict that the *Diadema* pathogen would eventually reach Barbados and that the island would be among the last places affected.

Fish larval behavior, as glimpsed through the handful of studies completed to date, appears diverse and fascinating (reference 3 of Bellwood *et al.*). What Bellwood *et al.* do not mention is that their own research has revealed such swimming and orientation abilities only in late-stage larvae. For a large proportion of the dispersal phase, fish larvae may have much less control over transport. Undoubtedly, there will be some species whose behavior will lead to high levels of local retention. How else can we account for species with very restricted ranges in regions where reefs are highly interconnected by currents (*1*)? But this is only one end of a spectrum of behavior, and there will be many other species whose dispersal will be more passive. Such behaviors will result in a spectrum of transport distances ranging from short to long.

Furthermore, while both letters emphasize fish behavior, the interests of managers extend to all of the other taxa that compose reef ecosystems. As Bellwood *et al.* point out, many invertebrate larvae seem to have little capacity to modify their transport by currents. The transport envelopes I describe cannot capture the detail of individual species' behaviors but, then, managers require broad guidance rather than reductionist complexity.

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Rapid-Wasting Disease: Pathogen or Predator?

Researchers have raised concern about the sudden emergence of coral diseases and the contagious nature of many of these diseases (*1*). A new "disease" was recently identified on star coral (*Montastraea annularis* species complex) and brain coral (*Colpophyllia natans*) from reefs of Bonaire, Netherlands Antilles. This affliction has been named "rapid-wasting disease" (RWD) because of the rate of tissue destruction (advancing 7.5 centimeters in 24 hours), associated with the removal of the top layers of calcium carbonate (Random Samples, 27 June 1997, p. 1979). While the extent of tissue loss ob-

Framework for Federal Science Policy

REQUEST FOR COMMENTS

The AAAS Board of Directors invites you to help develop a framework for our nation's science policy. The Board is preparing a paper on goals and directions for American science as input to the National Science Policy Study being conducted by the Science Committee of the U.S. House of Representatives. Members can read and comment on a draft of the Board's paper on the AAAS website at http://www.aaas.org/spp/fedsci. Feedback will be most helpful if received by April 8, 1998.