The expansionary era of American science has come to an end," says physicist David Goodstein of the California Institute of Technology. That's not news to Goodstein's fellow physicists, who have been buffeted by recession-induced corporate and government funding collapses, the end of the Cold War, and the paling of Big Physics signaled by the death of the Superconducting Super Collider. And it won't be news to beleaguered mathematicians: While unemployment figures for scientists as a class remain surprisingly low—1.4% as of 1991, according to the National Academy of Sciences—recipients of new mathematics Ph.D.s are suffering an unprecedented unemployment rate of 8.9%.

But most statistics fail to reflect the dislocations taking place: the numbers of young scientists in holding patterns of repeated postdocs, the shrinking numbers of those same scientists getting National Institutes of Health (NIH) grants (Science, 15 July, p. 314), the rise in the number of researchers holding temporary posts, and the expanding cohort taking longer to find jobs (see chart on next page).

To hear about these travails you need only tune in to the Young Scientists Network, set up by physicists who have been publicly fretting over what they see as bleak career prospects. "The reality of discovering the negative economic value of a Ph.D. is absolutely startling," says one networker, biophysicist Gene Nelson, who calls himself a "severely underemployed" computer programmer in Texas. Or you can listen to American Chemical Society (ACS) president Ned Heindel, age 57, of Lehigh University in Bethlehem, Pennsylvania, who says industry layoffs have hit his
field so hard that “my classmates of Ph.D. days live in
dread of a call from the human-resources person.”
Chemists are experiencing an unemployment rate of
2.7%, the highest in 20 years, according to the ACS.

In biology, though, “the situation is very different,”
says NIH director Harold Varmus. “Our enemy’s still
there.” At some elite research universities it even seems
to be business as usual. Neuroscientist Corey Goodman
at the University of California, Berkeley, says, for ex-
ample: “The people I tend to know, the students, the
postdocs—they’ve got jobs and they’re continuing to
get jobs. As far as I know, people who don’t get tenure
are the ones who haven’t done that well.” Yet even in
biology, “there are so many good people coming
through the ranks,” says Varmus, that “jobs are tough at
the moment.” Prospects are keyed to the ebb and flow
of opportunities in particular areas. Johns Hopkins Uni-
versity biologist Victor Corces, who works in a hot
field, drosophila genetics and development, says it’s suf-
ferring from a glut of researchers. Now biology faculty
“don’t want to hire drosophila people; they want to hire
zebrafish people.” Corces adds that whereas a few years
ago “100% of [Ph.D.] students would go into academia,
now perhaps 20%, discouraged by the money situation,
are going elsewhere, like law school. Finally, in envir-
onmental biology, according to ecologist Henry Howe
of the University of Illinois in Chicago, “the prospects
aren’t good and really haven’t been for quite a while.”
His students have found jobs, but only after “4 or 5 years
of postdocing.”

Playing the science game. How, then, do you
make your way in this changing world? “Overall,
there’s not much data scientists can look to” on these
questions, says sociologist Harriet Zuckerman of the Mellon Foun-
dation in New York. And, because the trendy questions in the soci-
ology of science now revolve around
the generation and reception of
knowledge, “people who used to
study careers are not fashionable
anymore.” Yet documenting the challenges scientists face—and
outlining strategies to meet them successfully—becomes ever more
important as the rules change.

Our reporters have therefore
interviewed dozens of scientists at
different career stages to find out
about these challenges and how
successful scientists handle them.
We start by exploring how you get
a postdoc that optimizes your
chances of landing a permanent
position. Then we look at the cri-
tera for promotion in industry,
and at alternative career paths,
such as teaching high school
science. Then we turn to midcareer challenges: How do you put your
best foot forward in a grant prop-
posal? What is the future of ten-
ure, and can you job-hop your way
from institution to institution for
a better future? How do you han-
dle unemployment? Finally, we
highlight issues that affect senior scientists, such as
successful strategies for lab and research-team man-
agement and making the decision on when—and
how—to retire.

Sea change. The challenges facing individual
researchers are mirrored in—and often rooted in—chal-
lenes facing scientific institutions. Kumar Patel, vice
chancellor of research at the University of California,
Los Angeles, last June hosted a meeting on “reinvent-
ing the research university” where he observed, “One
could say that research universities have become accus-
tomed to high-octane fuel for too long, and that time is
here to retune the engines for a lower octane fuel.”
Goodstein of Caltech says that in order to stay viable,
research universities “have to forge a future based on a
mixed economy”—that is, much closer involvement
with for-profit concerns to make up for the shrinkage
of federal support. At Caltech, he says, they’ve been lay-
ing the groundwork with a new set of conflict-of-interest
guidelines and an intellectual property office. For
the individual scientist in the new entrepreneurial en-
vironment, “life is going to be difficult because it will be
harder and harder to find ways to finance research,” says
Goodstein.

Former presidential science adviser Edward E. David
Jr. believes that the government will have to undergo a
major shift in the way it supports research, moving to a
system dominated by contracts for targeted research
rather than grants for investigator-initiated proposals.
But there’s no unanimity on such future visions—
people like Goodman of Berkeley say that in biology,
basically, investigator-initiated research is likely to remain
a top priority.

The new-paradigm grad student. Nonetheless,
many observers feel that the impetus in the air for
targeted research may have an effect on graduate edu-
caution. ACS president Heindel notes that in academic
science, “professors used to think they’d failed” if their
students didn’t replicate their own careers. “You were
out there to clone yourself and produce one more sup-
pliant at the federal funding trough.” Now, though,
“the litter’s gotten [too] big.”

It also may have become too specialized. At a Cali-
ifornia workshop hosted by Stanford University and the
National Research Council last June, scientists and
university administrators discussed the “new-paradigm
grad student,” a biology-physics hybrid. This new crea-
ture may have a dash of business experience as well:
Suggestions for broadening graduate training included
industrial internships for doctoral students. Redefining
the Ph.D. “is pretty radical stuff,” admits Stanford
chemist Richard Zare, but even if only 10% of graduate
students followed this pattern, “it would be a revolution
in the way efforts at universities are coupled to the
nation’s needs.”

Value in a changing world. Leaders such as Na-
tional Science Foundation director Neal Lane still
maintain that the Ph.D. is a great thing to have—a
versatile instrument like a law degree. “Young people
themselves don’t realize how valuable they are with a
Ph.D.,” says Lane. “It means an ability to think deeply,
solve problems, analyze data, criticize and be criti-
cized.” But Ph.D.s “often don’t realize the breadth of
what they are capable of doing.” Realizing those capa-
bilities is what this special issue of Science is all about.

—Constance Holden
Science careers: playing to win

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