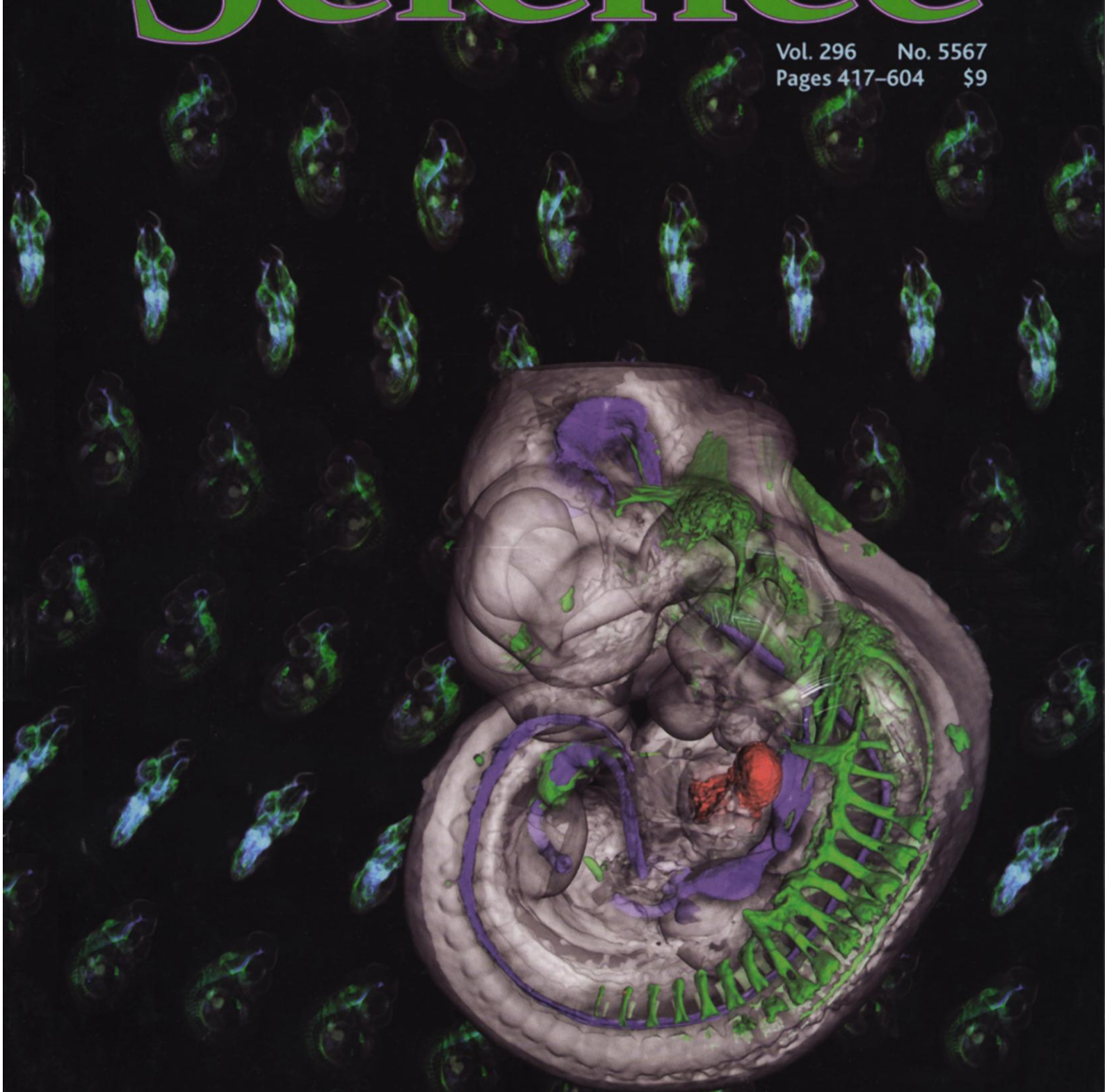
19 April 2002

Science

Vol. 296 No. 5567
Pages 417–604 $9

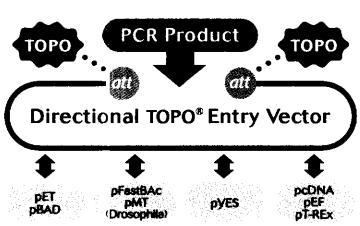


American Association for the Advancement of Science

Access the possibilities. Gateway™ for cloning and expression.

There are lots of ways to clone a gene. But only Gateway™ technology gives you ultimate access to multiple expression options. Rapidly clone your gene and—without subcloning—express it in as many systems as you choose.

Step in. Take the first step toward expression freedom by cloning your gene into the new Directional TOPO® entry vector. Your PCR – amplified gene is cloned in just 5 minutes for recombination with any Gateway™ destination vector.



Now express it. New Gateway™ destination vectors mean more expression possibilities. With a simple and rapid recombination step, insert your gene into the most advanced expression vectors available and express protein in bacterial, yeast, insect, or mammalian cells.

Now you can access rapid cloning and unlimited possibilities of expression with Gateway™ technology. For more information call Invitrogen or visit our web site today, **www.invitrogen.com/gateway**.

Invitrogen™
life technologies

Corporate Headquarters:
Invitrogen Corporation
1600 Faraday Avenue
Carlsbad, California 92008 U.S.A.
Tel: 1 760 603 7200
Tel (Toll Free): 1 800 955 6288
Fax: 1 760 603 7229
Email: tech_service@invitrogen.com

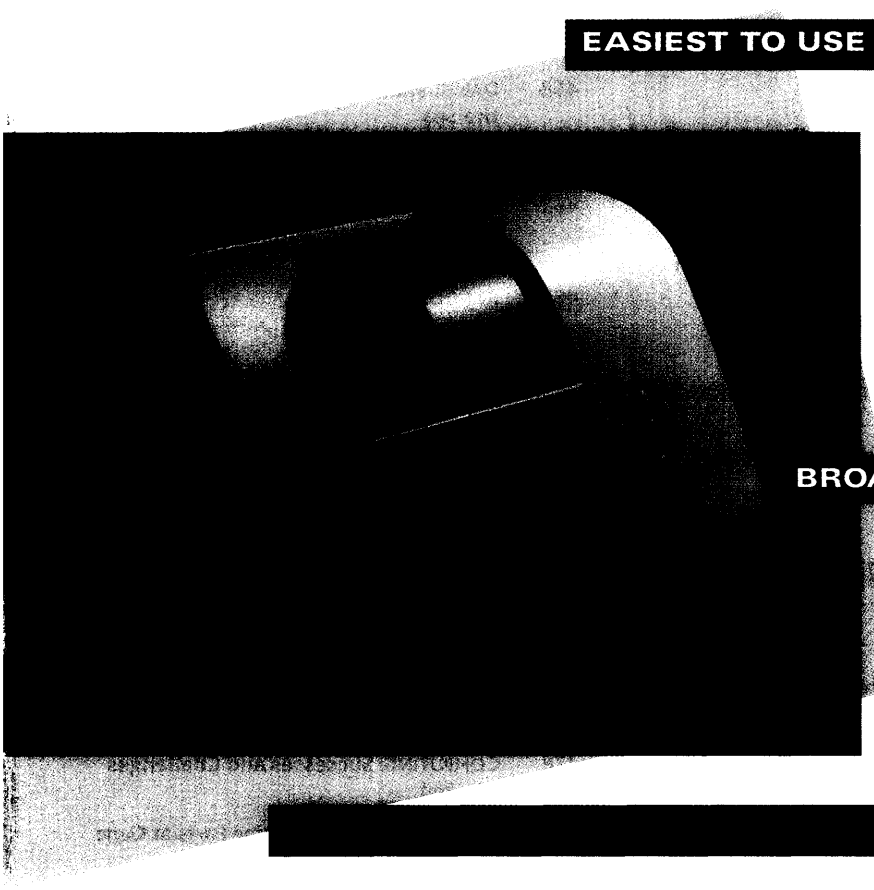
European Headquarters:
Invitrogen Ltd
3 Fountain Drive
Inchinnan Business Park
Paisley PA4 9RF, UK
Tel: +44 (0) 141 814 6100
Fax: +44 (0) 141 814 6260
Email: eurotech@invitrogen.com

For an office near you go to:
www.invitrogen.com

Quantitative PCR Just Got Easier!

Mx4000™

Multiplex Quantitative PCR System*



EASIEST TO USE QPCR SYSTEM

- *Real-time data analysis while experiment in progress*
- *Better multiplexing performance accelerates gene expression analysis*
- *Directly transfer applications to save time*
- *Short learning curve gets usable data faster*
- *Network multiple workstations for more flexibility*

BROADEST RANGE OF CHEMISTRIES

- *Supports all QPCR chemistries*
  - ***SYBR® Green***
  - ***TaqMan® probes***
  - ***Molecular beacons***
  - ***AmpliFluor™ primers***
  - ***Scorpions probes***
  - ***DNA binding dyes***

REAL MULTIPLEXING

- *Run and analyze multiple standard curves on the same plot*
- *View all dyes on a single plot*
- *Optics design allows use of all fluorescent dyes*

Mx4000™

Multiplex Quantitative PCR System

QPCR simplified.

STRATAGENE USA and CANADA
ORDER: (800) 424-5444 x3
TECHNICAL SERVICES: 800-894-1304

STRATAGENE EUROPE
Belgium, France, Germany, The Netherlands, Switzerland, United Kingdom
European Toll-Free Numbers
ORDER: 00800 7000 7000
TECHNICAL SERVICES: 00800 7400 7400
Austria
0800 312 526

www.stratagene.com

* Patent pending
See www.stratagene.com for licensing information

STRATAGENE®

Science

Volume 296 19 April 2002 Number 5567

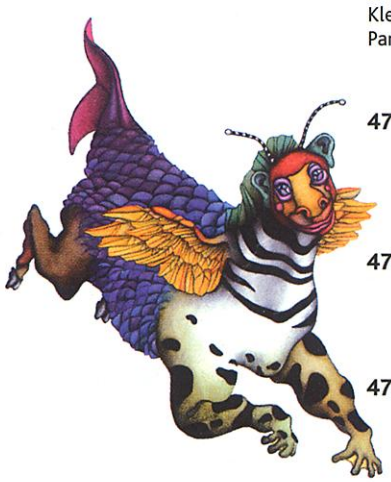
NEWS

454
Out of the deep freeze

458
Hooked on marine conservation

SCIENCE'S COMPASS

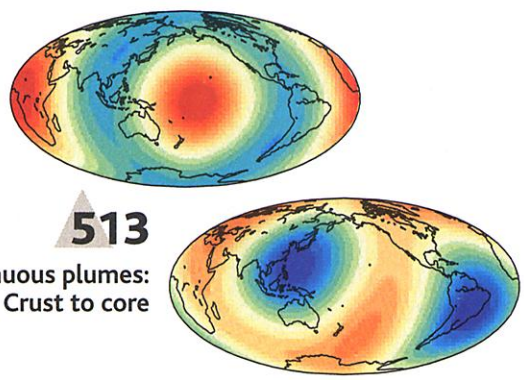
473
The biochemistry behind diverse physiologies



RESEARCH

BREVIA

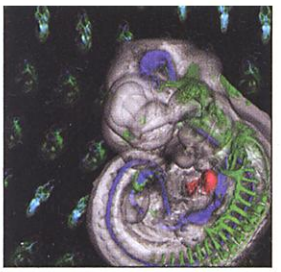
RESEARCH ARTICLES



513

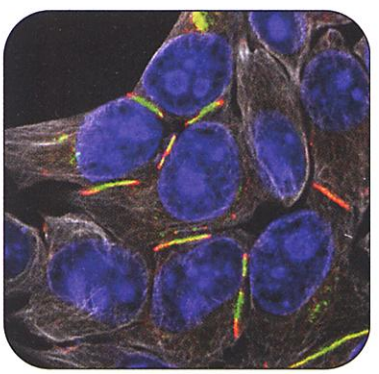
Continuous plumes: Crust to core

REPORTS



COVER 541

A mouse embryo 10.5 days after conception stained to show the expression pattern of two proteins, HNF3β (blue) and neurofilament (green). A microscopy technique based on optical projection tomography generates a three-dimensional image (foreground) from fluorescent images of the embryo at multiple stages during rotation (background). [Image: J. Sharpe and U. Ahlgren]



503

Getting into the gap (junction)

New on *Science* Express

New insect group discovered

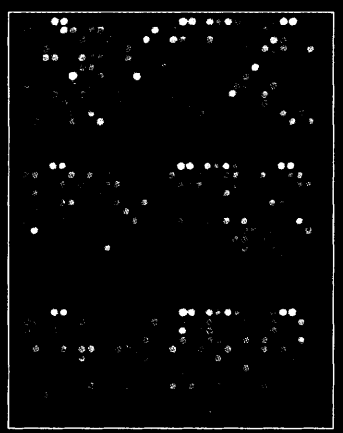
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

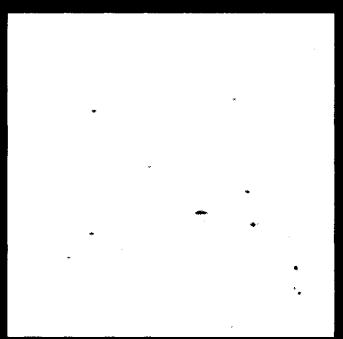
SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices.

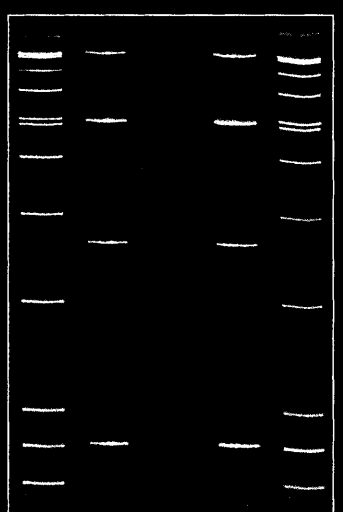
Domestic individual membership and subscription (51 issues): $120 ($66 allocated to subscription). Domestic institutional subscription (51 issues): $390; Foreign postage extra: Mexico, Caribbean (surface mail) $55; other countries (air assist delivery) $85. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. **Printed in the U.S.A.**

Change of address: allow 4 weeks, giving old and new addresses and 8-digit account number. **Postmaster:** Send change of address to *Science*, P.O. Box 1811, Danbury, CT 06813–1811. **Single copy sales:** $9.00 per issue prepaid includes surface postage; bulk rates on request.

The identification code for *Science* is 0036-8075/83 $8.00. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.







VIEW IT *all* FROM YOUR BENCHTOP

Want to view, analyze and document data that's invisible to the eye? And do it efficiently on samples such as PCR products, 2-D protein gels, macroarrays, blots, tissue sections—even microarrays? Good news: now you can do high resolution, high sensitivity imaging and analysis in the same manner and on the same instrument. Look to the new Typhoon™ 9410.

NEW Typhoon 9410

The only large format gel/blot imager available that also lets you handle microarrays

The new Typhoon 9410 is an extremely sensitive high-throughput, multi-mode imager. Its optics and low uniform background enable extremely low limits of fluorescence detection and uniform images. And you get accurate, publication-quality results on the first try, too. You can perform one- to four-color fluorescence image analysis of any sample—thick, thin, wet, or dry—on Typhoon. You can work with a wide variety of dyes and choose amongst storage phosphor, fluorescence or chemiluminescence detection modes. What's more, different Typhoon imager models are available, allowing you to more directly address qualities of your specific target types.

Go to **www.amershambiosciences.com/typhoon** for more information about the new Typhoon 9410, the imager that lets you view it all.

Anything is possible.

Amersham Biosciences

Amersham Pharmacia Biotech UK Limited,
Amersham Place, Little Chalfont,
Buckinghamshire, England HP7 9NA.

Scienceonline

www.scienceonline.org

CONTENT HIGHLIGHTS AS OF 19 APRIL 2002

science magazine

www.sciencemag.org

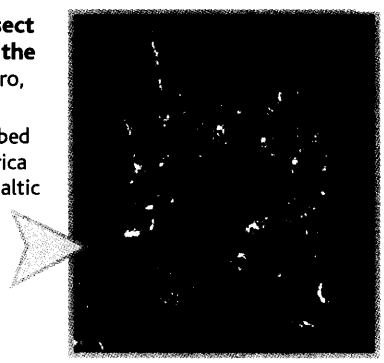
SCIENCE EXPRESS

www.sciencexpress.org

Mantophasmatodea: A New Insect Order with Extant Members in the Afrotropics K.-D. Klass, O. Zompro, N. P. Kristensen, J. Adis

▼445

A new order of insects is described from specimens collected in Africa and from a fossil preserved in Baltic amber.



A Single Molecular Spin Valve J. H. Schön, E. G. Emberly, G. Kirczenow

A single molecule placed between two ferromagnetic electrodes is shown to act as a spin valve.

Structure of the C-Cadherin Ectodomain and Implications for the Mechanism of Cell Adhesion T. J. Boggon, J. Murray, S. Chappuis-Flament, E. Wong, B. M. Gumbiner, L. Shapiro

A meshwork of cadherins enables cells to adhere to each other.

science's next wave

www.nextwave.org

career resources for scientists

CANADA: Your First Job in Clinical Research—What's Required? L. McKarney

For those fresh from earning an M.Sc. or a Ph.D., the odds of landing a job as a clinical research associate or project manager are not as good as they used to be. Here are a few things you can do to improve your chances.

US: You've Got the Data—Now Advocate for Change! O. M. Buxton and S. L. Gasior

Chicago postdocs learn the ropes of policy development—and, like Odysseus, find that their voyage is long and their vehicle for change is ever-evolving.

SINGAPORE: Impressions of South East Asia L. Yang

A view of science in South East Asia through the eyes of a foreigner who has worked and traveled extensively in the region.

UK: Stand Out from the Crowd P. H. Dee

Your first postdoc is your last chance to reinvent yourself, says our *Yours Transferredly* columnist.

NETHERLANDS: New Plans for Better Mentoring R. Metzke

Amsterdam's Free University reacts to a Ph.D.-students' report in a public discussion involving students, staff, and politicians.

KNOWLEDGE ENVIRONMENTS

science's sage ke

www.sageke.org

science of aging knowledge environment

This Is Your Brain—And This Is Your Brain on Calcium M. Leslie

Does calcium overload cause the fading faculties of the elderly?

Go Forth and Multiply R. J. Davenport

Mutations in mitochondrial DNA proliferate and take over.

science's stke

www.stke.org

signal transduction knowledge environment

Review: Endocannabinoids and Neuroprotection R. Mechoulam, M. Spatz, E. Shohami

Endogenous cannabinoids ameliorate inflammation and trauma associated with brain injury.

Protocol: Protein Lipid Overlay Assay S. Dowler, G. Kular, D. R. Alessi

A simple method to establish the lipid-binding properties of proteins and isolated lipid-binding domains.

Connections Map: Type I IFN (α/β) Pathway Pathway Authorities: D. Aaronson and C. Horvath

A canonical pathway of type I interferon signaling.

ONLINE STAFF

SCIENCENOW EDITORS Martin Enserink, Laura Helmuth, Greg Miller, Erik Stokstad

SCIENCE'S NEXT WAVE EDITORIAL: MANAGING EDITOR Crispin Taylor; EDITORS Eick von Ruschkowski (Germany), Kirstie Urquhart (UK), Ric Weibl (US); CONTRIBUTING EDITORS Lesley McKarney (Canada), Robert Metzke (Netherlands), Jennie Wong (Singapore); PROJECT EDITORS Jim Austin, Sibrina Collins, Katie Cottingham, Laure Haak; PRODUCTION ASSOCIATE Lily Han; MARKETING: MARKETING MANAGERS Karen Horting (Global), Hazel Crocker (Europe); PROGRAM DIRECTOR Lisa Kozlowski; MARKETING ASSOCIATE Angela Walker; PROGRAM ASSOCIATES Shajuan Martin, Tammy Minor

AIDSCIENCE SENIOR EDITOR Roberto Fernandez-Larsson; ASSOCIATE EDITOR Paula Werner

SCIENCE'S STKE EDITOR Bryan Ray; MANAGING EDITOR Nancy Gough; ASSOCIATE EDITORS Lisa Chong, John Nelson; PUBLICATIONS ASSISTANT Christopher Kenny

SCIENCE'S SAGE KE EDITORIAL DIRECTOR Kelly LaMarco; SENIOR NEWS EDITOR Evelyn Strauss; ASSOCIATE EDITOR R. John Davenport

ELECTRONIC MEDIA MANAGER Don Hemenway; INTERNET PRODUCTION MANAGER Betsy Harman; ASSISTANT PRODUCTION MANAGER Wendy Stengel; SENIOR PRODUCTION ASSOCIATES Darcee O'Donnell, Lisa Stanford; ASSOCIATES Carla Cathey, Steve Kusek, Louis Williams; LEAD APPLICATIONS DEVELOPER Carl Saffell

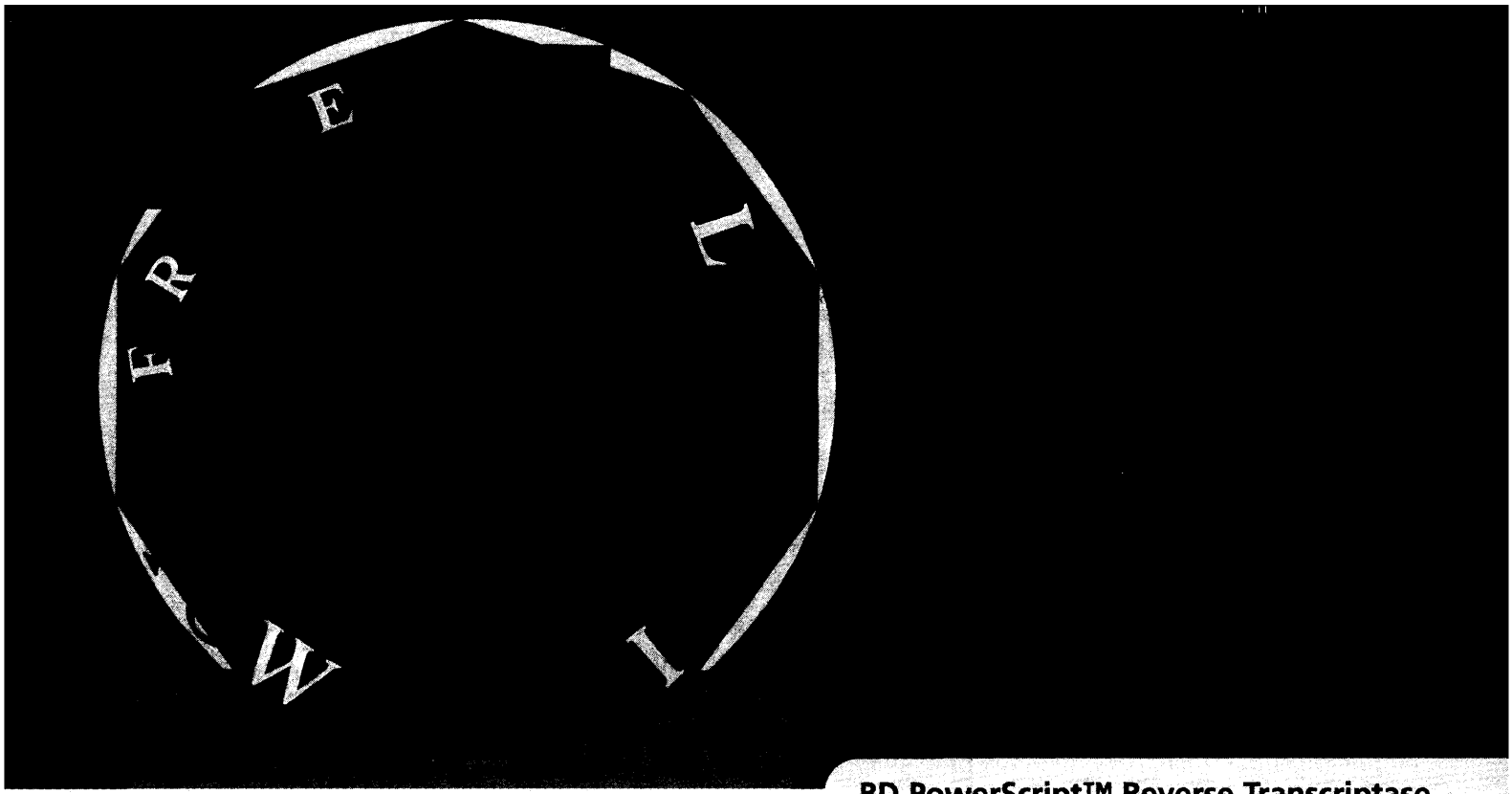


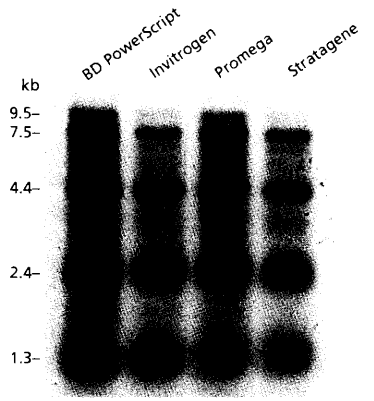
Illustration inspired by the art of Robert Indiana.

BD PowerScript™ Reverse Transcriptase

Power through.

Get the power of longer cDNAs for less money with **BD PowerScript™ Reverse Transcriptase** (RT). BD PowerScript is a superior point mutant of the Moloney murine leukemia virus RT that lacks RNase H activity but retains the wild-type polymerase ability—so you consistently get cDNAs longer than 3 kb. BD PowerScript is cleaner than other commercially available RTs. In fact, we guarantee each preparation to be free of DNase and RNase. And it costs less, making BD PowerScript RT clearly the most economical and best choice for cDNA library construction, RT-PCR, labeling probes, or any application requiring robust reverse transcription.

Call and order today!



Superior first strand cDNA synthesis from BD PowerScript™ RT. A poly A⁺ RNA ladder was incubated with equivalent amounts of different RNase H⁻ RTs using the conditions recommended by each manufacturer. BD PowerScript generated the largest yield of the 9.5 kb fragment.

BD Biosciences

Clontech
Discovery Labware
Immunocytometry Systems
Pharmingen

BD

BD Biosciences Clontech

www.bdbiosciences.com

United States	Canada	Europe	Japan	Asia Pacific	Latin America/Caribbean
877.232.8995	888.259.0187	32.53.720.211	81.24.593.5405	65.6861.0633	55.11.5185.9995

For country-specific contact information, visit **www.bdbiosciences.com/how_to_order/**

THIS WEEK IN Science

edited by Phil Szuromi

Nuggets from the Core

Highly siderophile elements are concentrated in Fe-metal rich phases during melting and crystallization. Geochemists have used these elements to estimate the composition, structure, and timing of core formation. Meibom and Frei (p. 516; see the Perspective by Carlson) analyzed the Re-Os isotopic systematics from placer deposits associated with ophiolites. The high $^{186}Os/^{188}Os$ and low $^{187}Os/^{188}Os$ ratios are opposite to those of normal mantle; in fact, if these are unaltered samples of the outer core, then the inner core must have formed within 250 million years of Earth's formation.

The Layered Look

Theoretical studies have suggested that fluids show several layers of ordering near flat surfaces as a result of how force changes across the interface. Recent x-ray diffraction measurements have shown such ordering for relatively complex liquids. Donnelly *et al.* (p. 507; see the Perspective by Johnson) have used high-resolution transmission electron microscopy to provide real-space images of a much simpler system, liquid xenon confined to small cavities in aluminum. They identify density variations attributed to layering near the cavity walls. Molecular dynamics simulations show that the crystallographic structure across the entire cavity can be determined by the geometry of the cavity. As a result, xenon will be in the body-centered cubic rather than the usual face-centered cubic structure. EX

Weeding Out the Little Guys

In typical filtration membranes, smaller molecules preferentially pass through tortuous pathways, but if the membrane is made more selective, it becomes less permeable. Reverse-selective membranes do exist, and they allow larger molecules through preferentially due to their higher solubility in the membrane. Merkel *et al.* (p. 519; see the news story by Service) show that fumed silica can be used as a filler material to improve both the selectivity and permeability of a number of polymer membranes by altering the distribution of the polymer chains, creating pockets of free volume through which larger molecules can diffuse without increasing the permeability to smaller ones.

Getting Connected

In order to study the dynamics of subcellular structures, it would be useful to observe the recruitment of newly synthesized components and their subsequent fates in real time and to be able to follow this with examination at the ultrastructural level. Gaietta *et al.* (p. 503) have done just this by developing a fluorescent labeling technique that can discriminate old and newly synthesized gap junction proteins in living cells and that can be followed by electron microscopic analysis. New gap junction components are delivered to the edge of existing complexes, while older components are removed from the center.

499 Electrophoretic DNA Computers

The nature of DNA computing makes it a natural for large search problems, such as conditional Boolean logic problems that involve a large number of variables and clauses. Braich *et al.* (p. 499; see the Perspective by Reif) used a DNA computer to solve a 20-variable, 24-clause logic problem (a 3-conjunctive normal form formula) that was designed to have only one correct answer out of the 2^{20} (~1 million) possible truth assignments. Each variable was represented as true or false by two different 15-base sequences. The 300-mer DNAs that represent all possible solutions were then analyzed in an electrophoretic box with a hot stage for releasing the library and a cold stage for capturing DNAs that satisfy the first clause. The nonsatisfying strands wash out, and the process is repeated with the cold stage becoming the hot stage and a new cold stage probe inserted for the second clause. This process is repeated for all of the clauses, and the final answer is read out after PCR amplification. EX

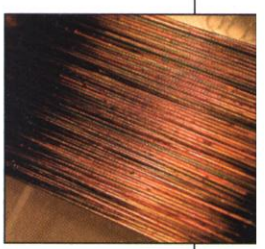
And in Brevia ...

Random integration of a retroviral vector, a common tool in gene therapy, is shown by Li *et al.* (p. 497) to induce leukemia in a mouse model.

CO_2 Cap for Cold Climate

A ubiquitous feature of glacial terminations is a rise in the concentration of atmospheric CO_2. Marine and atmospheric records of the stable carbon-isotopic composition of CO_2 show a rapid drop in $^{13}C/^{12}C$ at the end of the last glacial period. Spero and Lea (p. 522) propose a mechanism to link the carbon isotope minima seen at the onsets of glacial terminations with Antarctic/Southern Ocean warming, changes in ocean circulation, and rises in pCO_2. Their mechanism provides support for sea ice/destratification models and explains the rapid increase in atmospheric CO_2 at the end of glacial cycles as being initiated by Antarctic/Southern Ocean warming.

The Gold Standard



Polymer fibers are mechanically robust and lightweight, but generally have poor optical properties. High-quality dielectric mirrors, on the other hand, are fragile and expensive to fabricate. Hart *et al.* (p. 510) combine the desirable attributes of polymer fibers and dielectric mirrors to form fibers that are highly reflecting. The optical properties of the fiber can be tuned during the fiber-forming process, and the reflectivity is better than gold, the standard metal used for high-quality optical instruments.

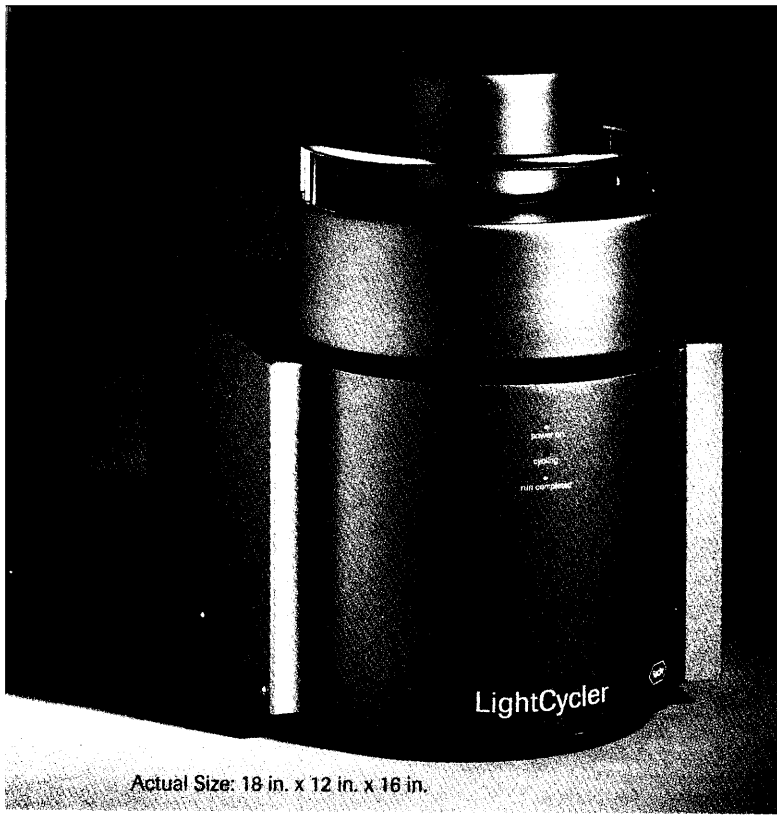
Weeding Out Even Littler Guys

The bacterial protein GlpF is an aquaporin and transports water and glycerol. Tajkhorshid *et al.* (p. 525) have studied the critical characteristics that govern permeability. Structures of GlpF in the presence and absence of glycerol were used for nanosecond simulations of water movements through the channel. These results led to a prediction of permeability for a GlpF mutant that, when constructed and solved, confirmed that two central asparagines block proton movement but permit water to pass.

CREDIT: HART *ET AL.*

EX Published online in *Science* Express

CONTINUED ON PAGE 427



Don't Get Stuck with a Real-Time PCR System that Can't Meet Your Evolving Research Needs!

Perform mutation analysis, quantitative PCR, or SNP analysis with **the extremely flexible LightCycler System from Roche Applied Science**. Amplify and analyze 32 samples in 30 minutes or less, monitoring reaction products on-line during each cycle – in *true* real-time PCR! Choose a versatile system that combines the reagents and instrumentation you'll need – wherever your research takes you in the future:

- **Don't limit your research to a single chemistry:** LightCycler Instrument owners run Hybridization Probes, SYBR Green I, TaqMan probes, molecular beacons, and more.
- **Perform diverse applications:** Quantify DNA copy number and mRNA expression levels, detect mutations, view melting curve characteristics, and much more.
- **Simultaneously analyze multiple targets:** Use single-color (Figure 1) or dual-color detection in multiplex PCR.

Upgrade the performance of other real-time PCR instruments

If you have already purchased a different real-time PCR instrument, upgrade its performance by **using LightCycler PCR and RT-PCR reagents that:**

- **perform exceptionally well on all platforms**
- **are recommended by real-time PCR instrument manufacturers** who lack their own reagents.

Whether you need a flexible instrument/reagent system or want to enhance real-time PCR on your current instrument, be sure to visit ***www.roche-applied-science.com/LightCycler*** today!

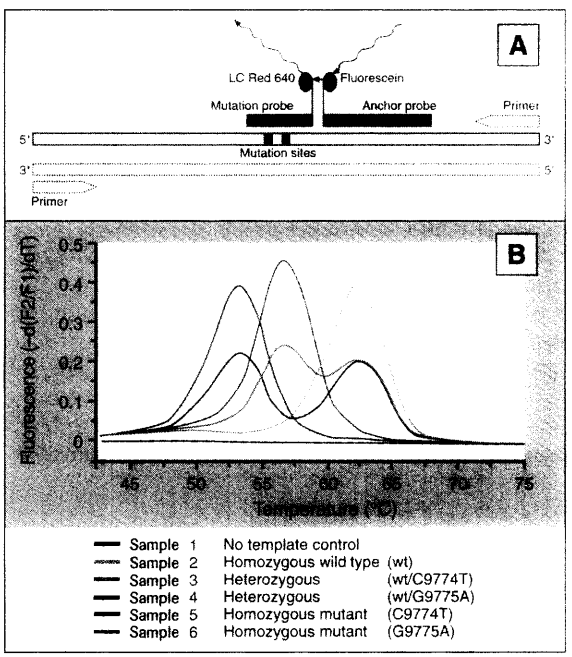


Figure 1: Single-color experiment to simultaneously detect two point mutations on the same gene within one amplicon.
A) Schematic presentation of the Apolipoprotein B PCR fragment.
B) Melting curve analysis of different genotypes of the analyzed sequence.

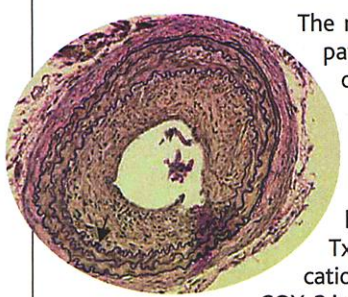
Roche

Roche Diagnostics Corporation
Roche Applied Science
Indianapolis, IN

Cellular Invasions

In order to infect a cell, a virus must first gain entry. Pelkmans *et al.* (p. 535) examined how simian virus 40 (SV40) enters via membrane specializations known as caveolae. The virus stimulates the internalization of the caveolae, which requires the breakdown of an actin meshwork. The virus-loaded caveolae bind to the free actin, which forms comet-like tails that propel the loaded caveolae farther into the cell.

The Heart of Eicosanoid Action



The roles of prostacyclin (PGI_2) and thromboxane (TxA_2) in the pathogenesis of cardiovascular disease have been debated for over 30 years. Cheng *et al.* (p. 539; see the Perspective by Vane) show that PGI_2 modulates platelet-vascular interactions in vivo and limits the deleterious vascular proliferative response to TxA_2. In contrast to aspirin, which suppresses both PGI_2 and TxA_2, the recently introduced cyclooxygenase-2 (COX-2) inhibitors suppress PGI_2 only. The interplay between PGI_2 and TxA_2 could be the molecular basis of the cardiovascular complications that have been seen in some patients who have substituted COX-2 inhibitors for aspirin.

Taking an In-Depth View

Recent advances in three-dimensional (3D) optical microscopy have greatly improved imaging for medical histopathology and developmental genetics. Sharpe *et al.* (p. 541; see the cover) now report a noninvasive, virtual sectioning technology for larger specimens (up to 15 millimeters in diameter), called optical projection tomography (OPT). This technique can produce high-resolution 3D images of both fluorescent and nonfluorescent specimens.

Malaria Drug Regulation

Antifolate drugs have been used against malaria for decades; however, no one has fully understood the basis for their selectivity. Zhang and Rathod (p. 545; see the Perspective by Goldberg) have now identified a key contribution. Antifolates target a bifunctional enzyme in the parasite called dihydrofolate reductase–thymidylate synthase. In humans, these activities reside in two separate proteins, and antifolates interfere with binding of the cognate messenger RNA (mRNA), disrupting the normal regulation of enzyme levels. Thus, continued translation produces more enzyme, counteracting drug inhibition. In the parasite, mRNA binding occurs far from the active site; therefore, translation stops, and drug action is not thwarted.

Complexes Within Complexes

When a cellular protein is no longer needed, a proteasomal complex is often used to degrade the unneeded protein. However, proteasomal subunits are now known to be active in nuclear excision repair and transcription elongation. Gonzalez *et al.* (p. 548; see the Perspective by Ottosen *et al.*) use biochemical and genetic analyses to demonstrate that the transcriptional activator Gal4 recruits the 19*S*, but not the 20*S*, proteasome particle to a target gene.

Rare Lineage

A small subset of T lymphocytes express markers characteristic of natural killer (NK) cells and has been shown to regulate adaptive immune responses. Compared with conventional T cells, the development of these NKT cells is poorly understood, although it is known that they are positively selected by major histocompatibility complex–like CD1 ligands within the thymus. Benlagha *et al.* (p. 553; see the Perspective by MacDonald) used tetramer staining to characterize NKT cell precursors in wild-type populations of thymocytes and track their emigration from the thymus into peripheral tissues. The NK phenotype displayed by these cells actually occurred after these cells exited the thymus. More striking was a progression from expression of the cytokine interleukin-4 to interferon-γ, which may reflect distinct mechanisms of immune regulation mediated by these cells.

CREDIT: CHENG *ET AL.*

WISH YOU HAD OPTIONS FOR REAL-TIME PCR?

MGB-Eclipse™ Real-time PCR Probes. Now you can select any instrumentation system for your studies. How? MGB-Eclipse™ Real-time PCR Probes use open chemistries. And by combining Epoch's Minor Groove Binder (MGB) and our novel Eclipse™ Quencher, the MGB-Eclipse™ Probes generate dramatically improved signal-to-noise ratios. Use the complimentary MGB-Eclipse™ Design Software to select optimal probe and primer sequences at record speeds. Available in pre-made and custom-designed systems, it's a better way to get answers to your probing questions.

EPOCH
BIOSCIENCES

We listen.

For sales and information call **800-562-5544** or visit **www.epochbio.com**

Applied Biosystems *PCR* Licensing Program

At Applied Biosystems we are proud of our role in developing PCR technology. From the start, as the exclusive licensee of PCR for research and other non-diagnostic applications, we have provided scientists with innovative tools for PCR and access to the technology.

The Nobel Prize winning PCR process is covered by patents in many countries throughout the world. Because PCR is patented, using PCR, even for research, requires a license. In keeping with our philosophy of maximizing scientists' access to PCR, Applied Biosystems makes licenses available in a number of ways. To make it easy for users to obtain the PCR rights they need, we not only offer PCR rights in a variety of ways directly to end users, we also have licensed many of our competitors to convey these rights with their products.

Obtaining a license to perform automated PCR for your own research is easy. You can obtain the license automatically by using a licensed DNA polymerase (available from over 25 manufacturers) with an Authorized thermal cycler (available from a number of thermal cycler suppliers). Alternatively, if you choose not to use products from Applied Biosystems or other licensed manufacturers, you need to purchase the appropriate PCR research rights directly from Applied Biosystems.*

Applied Biosystems also offers licenses for other uses of PCR (for example, for providing services) in a variety of fields, either directly through license agreements or through products from Applied Biosystems and licensed competitors which convey these rights. In addition to research, these fields include agricultural testing, animal identity testing, environmental testing, food testing, forensics and human identity testing, and quality control testing.

For more detailed information on how to obtain a license to practice the PCR process, please visit our website at:

www.appliedbiosystems.com/ab/pcrlicensefaq

Or contact us at: Applied Biosystems, Licensing Department, 850 Lincoln Centre Drive, Foster City, CA 94404 USA, fax: 650.638.6071, phone: 650.638.5845.

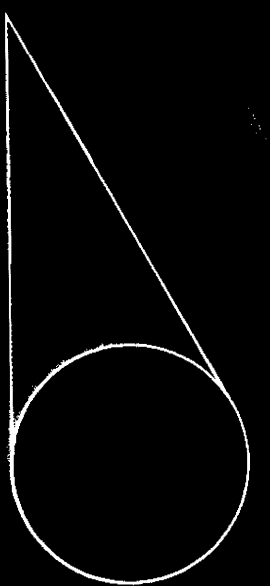
*Please note that, in addition to the PCR process rights, you may need other patent rights associated either with instruments or reagents.

Applied Biosystems

Leaf Tissue to PCR in Under 15 Minutes

Extract-N-Amp™ for Plants

- No Freezing or Grinding
- Increased Throughput
- Increased Specificity



Visit sigma-aldrich.com/XNAPs for more information.

The **Extract-N-Amp Plant PCR Kits** contain reagents to rapidly extract genomic DNA from plant leaves and amplify targets of interest by PCR. This novel extraction system eliminates the need for freezing, mechanical disruption, organic extraction, centrifugation, column purification, filtration or alcohol precipitation. The kit also includes a PCR reaction mix, especially formulated for amplification directly from extract.

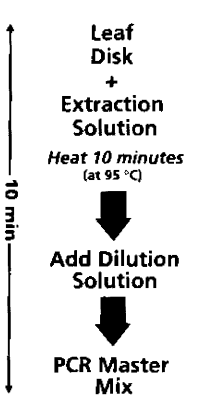
Features & Benefits:

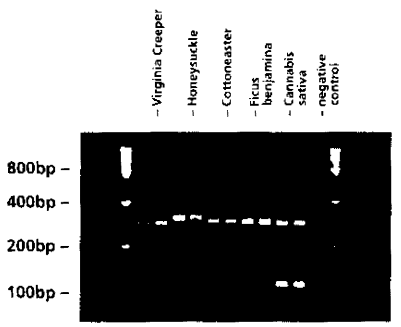
- **Fast: 15 minute prep allows greater speed and throughput**
- **Convenient: Simple procedure with no special equipment required**
- **Specific: Hot Start antibody for highly specific PCR amplification of genomic DNA**
- **Flexible: Tested on a wide variety of plant types**

ORDERING INFORMATION

Product Code	Description	Size
XNAP2	Extract-N-Amp Plant PCR Kit	100 extractions/100 amplifications
XNAP	REDExtract-N-Amp Plant PCR Kit (contains REDTaq)	100 extractions/100 amplifications

Inquire for bulk and high-throughput custom needs.





Extract-N-Amp Plant PCR Kit with 5 different plant specimens. *Genomic DNA was extracted from 0.5 cm leaf disks that were cut using standard paper punch. DNA was extracted using the Extract-N-Amp Plant PCR Kit in less than 15 minutes. All samples were then amplified using the specially formulated Hot Start PCR mix. The products were generated from a 30-cycle duplex reaction containing primers specific to plant chloroplast (upper band) and primers specific for Cannabis sativa DNA (lower band).*

Data provided by Andy Hopwood, Forensic Science Service, Birmingham, England.

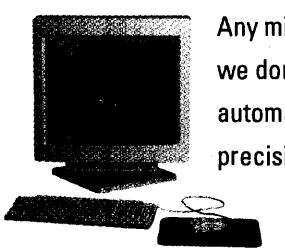
Contact Sigma for more information on Extract-N-Amp for Plants at sigma-aldrich.com/XNAPs

availability, ordering & tracking
sigma-aldrich.com
scientific tools, products & information

LEADERSHIP IN LIFE SCIENCE, HIGH TECHNOLOGY AND SERVICE
SIGMA-ALDRICH CORPORATION • BOX 14508 • ST. LOUIS • MISSOURI 63178 • USA

SIGMA®

Few things show you innovations as accurately as a microscope system.



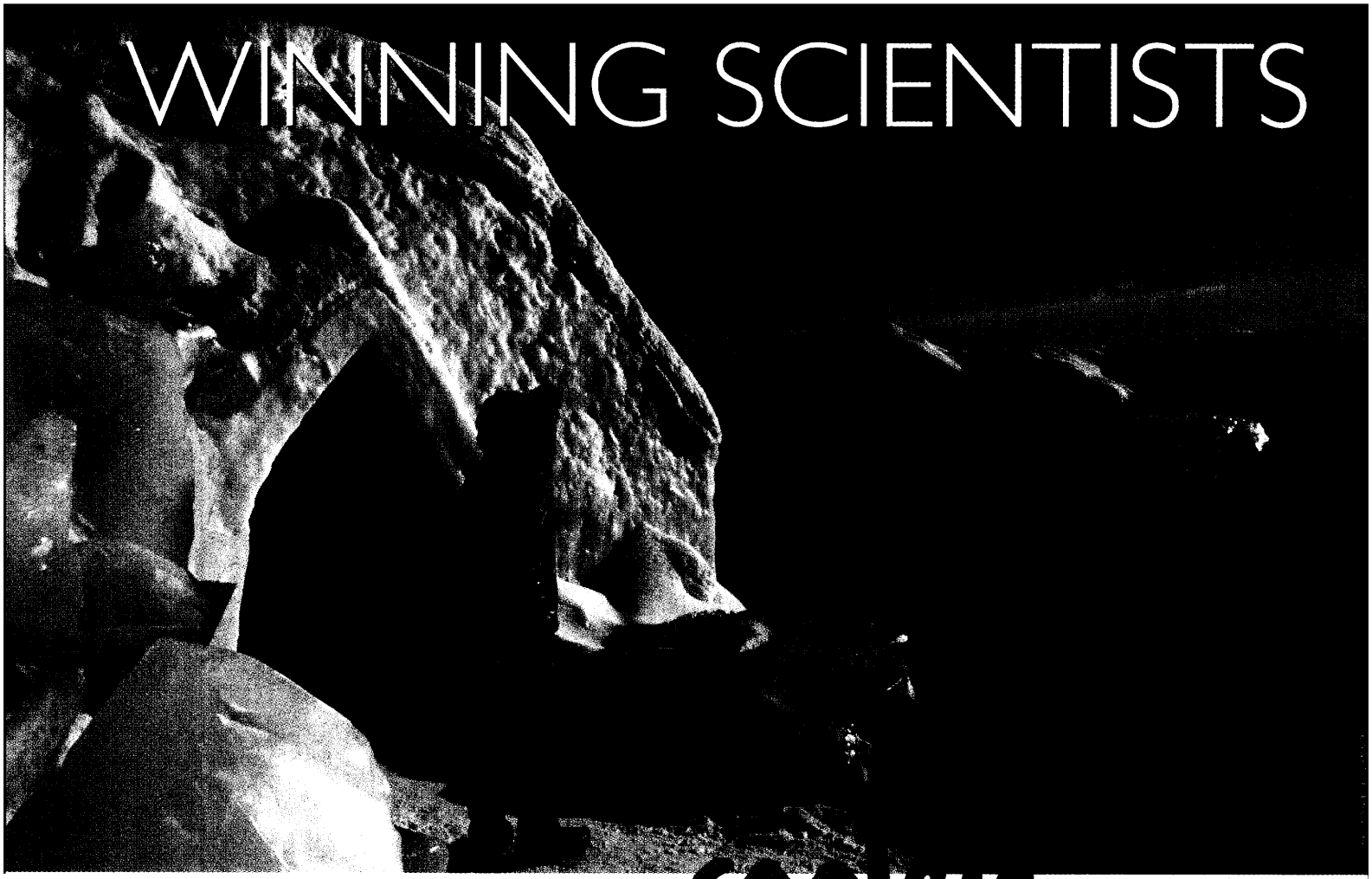
Any microscope image can only be precise as the optical systems that produced it. That's why we don't only concentrate on improving the technology of our microscope systems – even by automation – but also pay meticulous attention to their manufacture. The result: the high imaging precision essential today in biology, medicine or industry.

Leica Microsystems Wetzlar GmbH
Ernst-Leitz-Straße 17-37
D-35578 Wetzlar (Germany)

Tel. +49 (0) 64 41 29-0
Fax +49 (0) 64 41 29-25 99
www.leica-microsystems.com

Leica
MICROSYSTEMS

Microscopy 10/2001 e



COME FROM THE coolest PLACES

Raised north of the Arctic circle, near Sweden's famous Icehotel, Åsa Apelqvist was the regional winner of the 2001 Amersham Biosciences & *Science* Prize for Europe.

No matter where you come from, a journey of a thousand miles begins with a single step. So if you are embarking on the journey that is the study of science, here's your chance to gain international acclaim for yourself and your school. If you completed your Ph.D. in molecular biology* during 2001, describe your work in a 1,000 word essay. Then enter it into the 2002 Amersham Biosciences & *Science* Prize for young scientists.

Your essay will be reviewed by a panel of distinguished scientists, who'll select one grand prize winner and up to seven other winners. The grand prize winner will get his or her essay published in *Science*, receive US$25,000, and win a trip to the awards ceremony. Your essay may be submitted in English, French, German, Spanish, Japanese or Chinese (Mandarin). The closing date for entries is July 15, 2002.

Go to **www.amershamscienceprize.org** to obtain the mandatory entry form. And take your step. Jamie H. Cate did and won the regional prize for North America in 1998. What's more, he recently won a prize for the best paper published in *Science*—"Crystal Structure of the Ribosome at 5.5 Å Resolution" *Science*, **292:** 883-896 (2001).

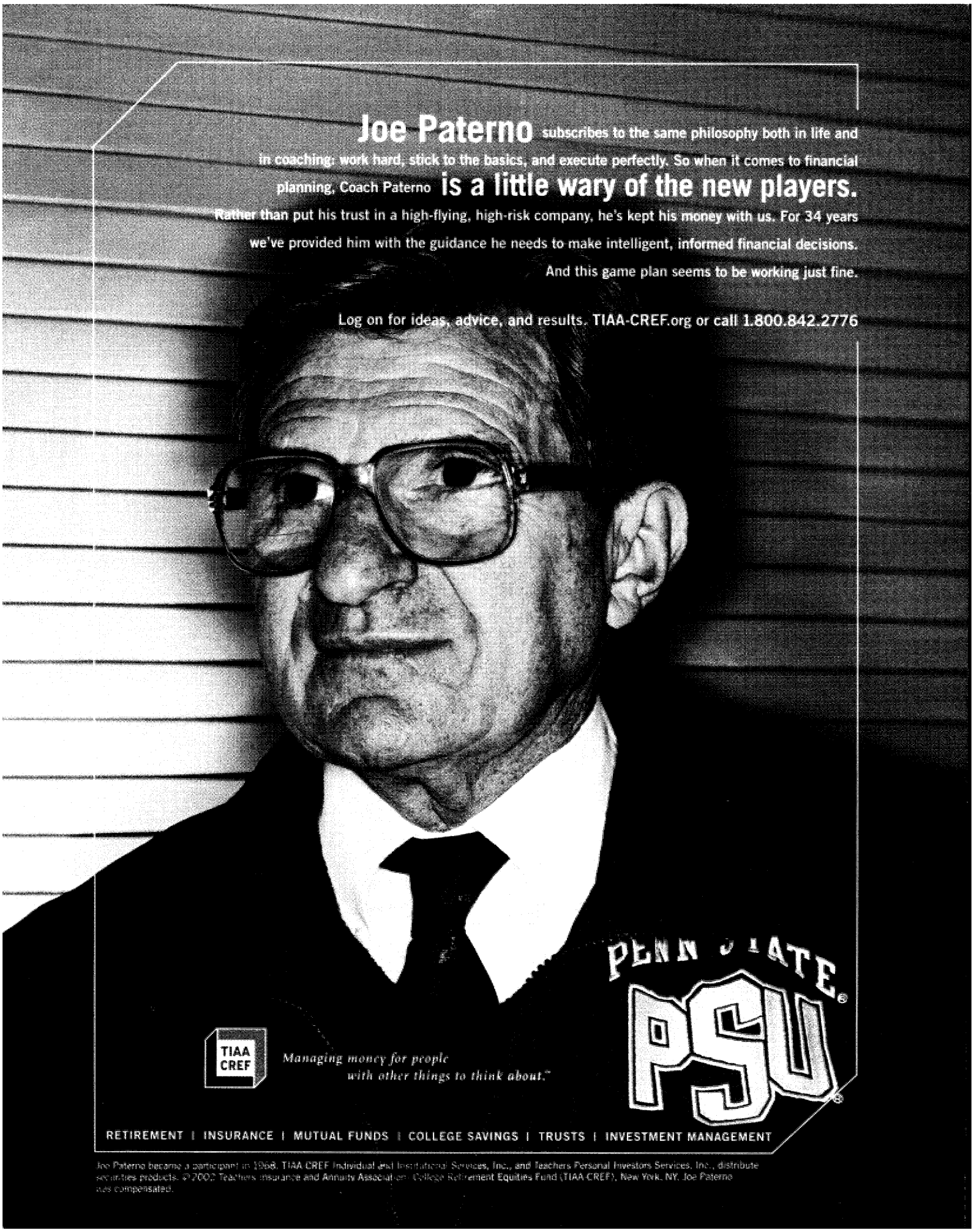
* For the purpose of this prize, molecular biology is defined as "that part of biology which attempts to interpret biological events in terms of the physico-chemical properties of molecules in a cell" (McGraw-Hill Dictionary of Scientific and Technical Terms, 4th Edition).

AMERSHAM BIOSCIENCES & SCIENCE

Prize FOR YOUNG SCIENTISTS

Science

Amersham Biosciences


Joe Paterno subscribes to the same philosophy both in life and in coaching: work hard, stick to the basics, and execute perfectly. So when it comes to financial planning, Coach Paterno is a little wary of the new players.
Rather than put his trust in a high-flying, high-risk company, he's kept his money with us. For 34 years we've provided him with the guidance he needs to make intelligent, informed financial decisions. And this game plan seems to be working just fine.
Log on for ideas, advice, and results. TIAA-CREF.org or call 1.800.842.2776
TIAA CREF
Managing money for people with other things to think about.™
PENN STATE
PSU
RETIREMENT | INSURANCE | MUTUAL FUNDS | COLLEGE SAVINGS | TRUSTS | INVESTMENT MANAGEMENT
Joe Paterno became a participant in 1968. TIAA-CREF Individual and Institutional Services, Inc., and Teachers Personal Investors Services, Inc., distribute securities products. ©2002 Teachers Insurance and Annuity Association-College Retirement Equities Fund (TIAA-CREF), New York, NY. Joe Paterno was compensated.

www.sciencemag.org

Science

1200 New York Avenue, NW
Washington, DC 20005
Editorial: 202-326-6550, FAX 202-289-7562
News: 202-326-6500, FAX 202-371-9227
Permissions: 202-326-7074, FAX 202-682-0816
Subscriptions: 800-731-4939 or 202-326-6417, FAX 202-842-1065

Bateman House, 82-88 Hills Road
Cambridge, UK CB2 1LQ
(44) 1223-326500, FAX (44) 1223-326501

EDITOR-IN-CHIEF **Donald Kennedy**
EDITOR **Ellis Rubinstein**
MANAGING EDITOR **Monica M. Bradford**

DEPUTY MANAGING EDITORS: R. Brooks Hanson, Katrina L. Kelner
NEWS EDITOR: Colin Norman

EDITORIAL/COMPASS SUPERVISORY SENIOR EDITORS Barbara Jasny, Guy Riddihough, Phillip D. Szuromi; SENIOR EDITOR/PERSPECTIVES Orla Smith; SENIOR EDITORS Gilbert J. Chin, Pamela J. Hines, Paula A. Kiberstis (Boston), L. Bryan Ray, Linda R. Rowan; ASSOCIATE EDITORS Lisa D. Chong, Marc S. Lavine, Beverly A. Purnell, H. Jesse Smith, Valda Vinson; EDITOR, *SCIENCE* ONLINE Stewart Wills; ASSOCIATE BOOK REVIEW EDITOR Sherman J. Suter; ASSOCIATE LETTERS EDITOR Etta Kavanagh; INFORMATION SPECIALIST Janet Kegg; CONTRIBUTING EDITOR Kevin Ahern; EDITORIAL MANAGER Cara Tate; SENIOR COPY EDITORS Jeffrey E. Cook, Harry Jach, Barbara P. Ordway; COPY EDITORS Lauren Beben, Joshua Marcy, Monique Martineau; EDITORIAL COORDINATORS Carolyn Kyle, Ellen E. Murphy, Beverly Shields; PUBLICATION ASSISTANTS Chris Filiatreau, Joi S. Granger, Jeffrey Hearn, Elise Laffman, Scott Miller, Gail Murphy, Brian White, Anita Wynn; EDITORIAL ASSISTANTS Lisa Johnson, Yolanda Matthews, Patricia M. Moore, Tunisia L. Riley; EXECUTIVE ASSISTANT Sylvia S. Kihara; ADMINISTRATIVE SUPPORT Patricia F. Fisher

science_editors@aaas.org (for general editorial queries)
science_letters@aaas.org (for letters to the editor)
science_reviews@aaas.org (for returning manuscript reviews)
science_bookrevs@aaas.org (for book review queries)

NEWS SENIOR CORRESPONDENTS Eliot Marshall, Jean Marx; DEPUTY NEWS EDITORS Robert Coontz, Jeffrey Mervis, Leslie Roberts; ASSOCIATE NEWS EDITOR Laura Helmuth; CONTRIBUTING EDITORS Elizabeth Culotta, Polly Shulman; NEWS WRITERS Jennifer Couzin, Martin Enserink, Constance Holden, Jocelyn Kaiser, Richard A. Kerr, Andrew Lawler (Boston), David Malakoff, Elizabeth Pennisi, Charles Seife, Robert F. Service (Pacific NW), Erik Stokstad, Katie Greene (intern); CONTRIBUTING CORRESPONDENTS Marcia Barinaga (Berkeley, CA), Kathryn Brown, Barry A. Cipra, Jon Cohen (San Diego, CA), Daniel Ferber, Ann Gibbons, Robert Irion, Mitch Leslie (NetWatch), Charles C. Mann, Virginia Morell, Evelyn Strauss, Gary Taubes, David Voss, Ingrid Wickelgren; COPY EDITORS Laura Atwood, Linda B. Felaco, Daniel T. Helgerman; ADMINISTRATIVE SUPPORT Scherraine Mack, Fannie Groom; BUREAUS: Berkeley, CA: 510-652-0302, FAX 510-652-1867, Boston, MA: 617-542-5098, San Diego, CA: 760-942-3252, FAX 760-942-4979, Pacific Northwest: 503-963-1940

PRODUCTION DIRECTOR James Landry; MANAGER Wendy K. Shank; ASSISTANT PRODUCTION MANAGER Rebecca Doshi; ASSOCIATES Vicki J. Jorgensen, Tara L. Kelly, Jessica K. Moshell, Amanda K. Skelton

PREFLIGHT OPERATIONS DIRECTOR David M. Tompkins

ART DESIGN DIRECTOR C. Faber Smith; ART DIRECTOR Alan T. Stonebraker; ASSOCIATE ART DIRECTOR Joshua Moglia; ILLUSTRATORS Cameron Slayden, Katharine Sutliff; ASSOCIATES Holly Bishop, Debra J. Morgenegg, Preston Morrighan; Julie White PHOTO RESEARCHER Leslie Blizard

***SCIENCE* INTERNATIONAL**

EUROPE (science@science-int.co.uk) EDITORIAL: SUPERVISORY SENIOR EDITOR Andrew M. Sugden; SENIOR EDITOR/PERSPECTIVES Julia Uppenbrink; SENIOR EDITORS Caroline Ash, Stella M. Hurtley; ASSOCIATE EDITORS Ian S. Osborne, Stephen J. Simpson, Peter Stern; EDITORIAL SUPPORT Jenny Parker, Sarah Parker; ADMINISTRATIVE SUPPORT Janet Mumford, Lara Crowe, Mark Chadwick; NEWS: EUROPEAN NEWS EDITOR Richard Stone; DEPUTY NEWS EDITOR Daniel Clery; CORRESPONDENTS Michael Balter (Paris: (33) 1-49-29-09-01, FAX (33) 1-49-29-09-00), Gretchen Vogel (Berlin: (49) 30-2809-3902, FAX (49) 30-2809-8365) Adam Bostanci (intern)

ASIA Japan Office: Asca Corporation, Eiko Ishioka, Fusako Tamura, 1-8-13, Hirano-cho, Chuo-ku, Osaka-shi, Osaka, 541-0046 Japan; (81) 6-6202-6272, FAX (81) 6-6202-6271; asca@os.gulf.or.jp JAPAN NEWS BUREAU: Dennis Normile (contributing correspondent, (81) 3-3335-9925, FAX (81) 3-3335-4898; dnormile@twics.com); CHINA REPRESENTATIVE Hao Xin, (86) 10-6307-4439 or 6307-3676, FAX (86) 10-6307-4358; science@public3.bta.net.cn; INDIA Pallava Bagla (contributing correspondent (91) 11-271-2896; pbagla@ndb.vsnl.net.in)

PUBLISHER **Alan I. Leshner**
ASSOCIATE PUBLISHER **Beth Rosner**
MEMBERSHIP/CIRCULATION DIR. **Michael Spinella**

MEMBERSHIP/CIRCULATION (membership@aaas.org) DEPUTY DIRECTOR Marlene Zendell; MEMBER SERVICES MANAGER Michael Lung; SENIOR SPECIALIST Mary Curry; COORDINATOR Jantell Stone; SPECIALISTS Laurie Baker, Pat Butler, Elizabeth Early, Katrina Smith; MARKETING: MANAGER Gregory Urquhart; PRODUCTION MANAGER Lauri Sirois; SENIOR ASSOCIATE Deborah Stromberg; INTERNATIONAL MARKETING MANAGER Ruth Hall; SENIOR EXECUTIVE Martin Paine; RESEARCH: MANAGER Renuka Chander; BUSINESS AND FINANCE: MANAGER Teressa Ellis; ADMINISTRATIVE SUPPORT Zadia McKinnon; COMPUTER SPECIALIST John Williams

SUBSCRIPTION SERVICES For change of address, missing issues, new orders and renewals, and payment questions: 800-731-4939 or 202-326-6417, FAX 202-842-1065. Mailing addresses: AAAS, P.O. Box 1811, Danbury, CT 06813 or AAAS Member Services, 1200 New York Avenue, NW, Washington, DC 20005

REPRINTS Ordering/Billing/Status 800-635-7171; Corrections 202-326-6501

MEMBER BENEFITS For Credit Card: MBNA 1-800-847-7378; Car Rentals: Hertz 1-800-654-2200 CDP#343457, Dollar 1-800-800-4000 #AA1115; AAAS Travels: Betchart Expeditions 1-800-252-4910; Life Insurance: Seabury & Smith 1-800-424-9883; Other Benefits: AAAS Member Services 1-202-326-6417.

FINANCE AND ADVERTISING BUSINESS MANAGER Deborah Rivera-Wienhold; SENIOR ANALYST Randy Yi; FINANCIAL ANALYSTS Lisa Donovan, Jessica Tiemey-Rubin; RIGHTS AND PERMISSIONS: ASSOCIATE Emilie David; ASSISTANT Karen Lentz; MARKETING: DIRECTOR John Meyers; RECRUITMENT MARKETING MANAGER Allison Pritchard; ASSOCIATES Mary Ellen Crowley, Amanda Donathen; ELECTRONIC MEDIA: MANAGER Don Hemenway; INTERNET PRODUCTION MANAGER Lizabeth Harman; ASSISTANT PRODUCTION MANAGER Wendy Stengel; SENIOR PRODUCTION ASSOCIATE Lisa Stanford; PRODUCTION ASSOCIATES Carla Cathey, Steve Kusek, Louis Williams; LEAD APPLICATIONS DEVELOPER Carl Saffell; ADMINISTRATIVE SUPPORT Joyce Scott

PRODUCT ADVERTISING (science_ advertising@aaas.org) NATIONAL SALES MANAGER Richard Teeling: 973-694-9173, FAX 973-694-9193 • NORTHEAST AND E. CANADA Elizabeth Pointek: 860-612-0306, FAX 413-480-0008• MIDWEST Rick Bongiovanni: 330-405-7080, FAX 330-405-7081 • WEST COAST/W. CANADA B. Neil Boylan: 415-458-1630, FAX 415-458-1631 • MID-ATLANTIC AND SOUTHEAST SALES Christopher Breslin: 443-512-0330, FAX 443-512-0331 • UK/SCANDINAVIA/FRANCE/ITALY/BELGIUM/NETHERLANDS Andrew Davies: 44 (0)1-782-750-111, FAX 44 (0)1-782-751-999 • GERMANY/SWITZERLAND/AUSTRIA Tracey Peers: (44) 1-782-752-530, FAX (44) 1-782-752-531 JAPAN Mashy Yoshikawa: (81) 3-3235-5961, FAX (81) 3-3235-5852 ISRAEL Jessica Nachlas 001 972-3-5449123 • TRAFFIC MANAGER Carol Maddox; SALES COORDINATOR Deiandra Underwood; SENIOR SALES ASSOCIATE Sheila Myers

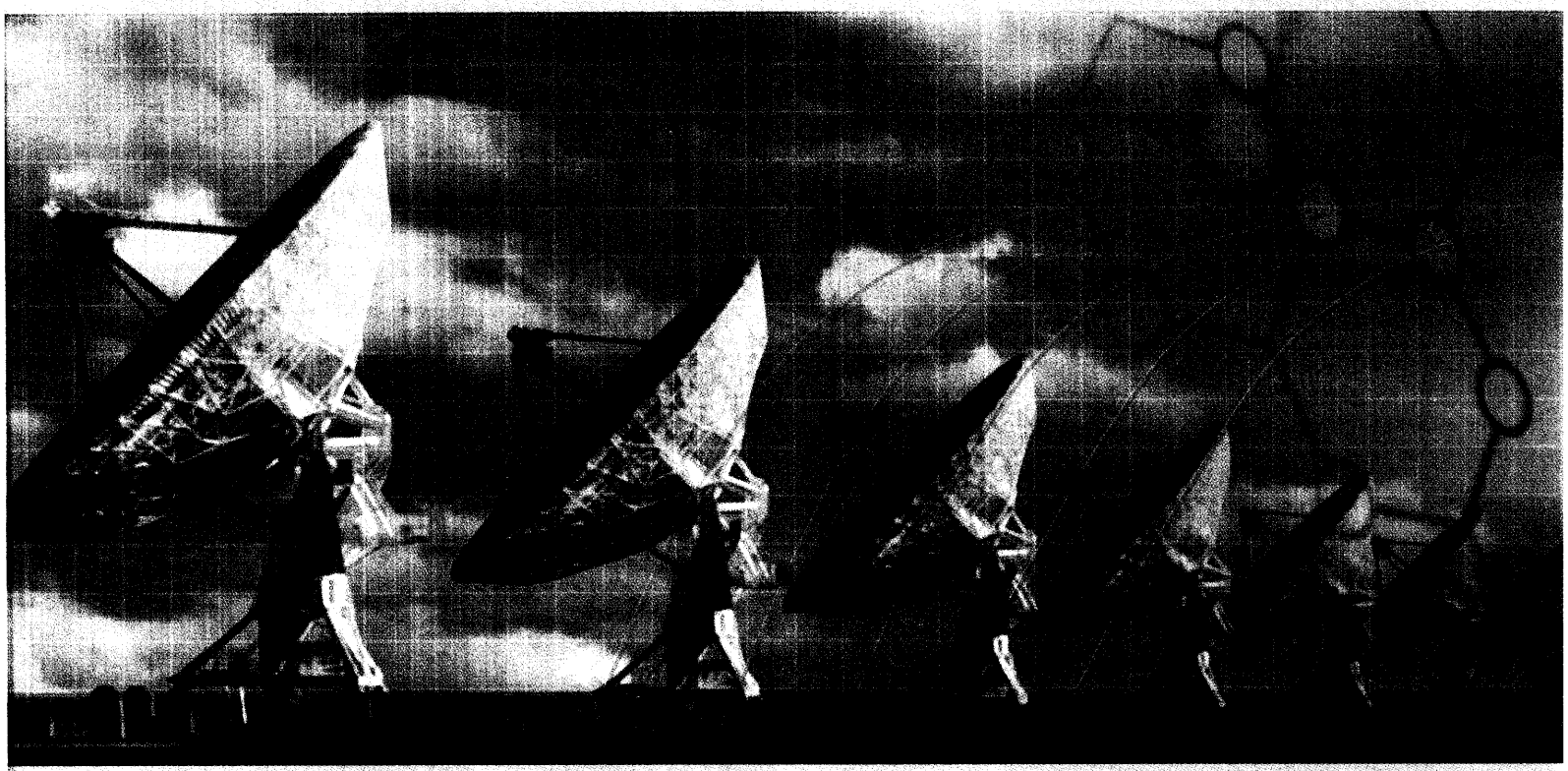
RECRUITMENT ADVERTISING (science_classifieds@aaas.org); PRODUCTION MANAGER Jennifer Rankin; ASSISTANT PRODUCTION MANAGER Deborah Tompkins; U.S.: SALES MANAGER Gabrielle Boguslawski: 718-491-1607, FAX 202-289-6742; WEST COAST SALES MANAGER Kristine von Zedlitz; EAST COAST SALES MANAGER Jill Steinberg; INTERNET SALES MANAGER Beth Dwyer; ASSISTANT SALES MANAGER Daryl Anderson; SENIOR SALES COORDINATOR Erika Bryant; SALES COORDINATORS Rohan Edmonson, Caroline Gallina, Shirley Young; SALES REPRESENTATIVES Kathleen Clark, Sussy Castilla, Christina Geiger, Bren Peters-Minnis; ASSISTANTS Emnet Tesfaye, Timothy Hawk; ASSOCIATES Christine Hall, Dina Freeman, Greta Springett; PUBLICATIONS ASSISTANTS Robert Buck, Jane Vaughn; U.K./EUROPE: SALES MANAGER Debbie Harris; PROMOTIONS COORDINATOR Richard Walters; INTERNET SALES EXECUTIVE Tracy Holmes; AUSTRALIA/NEW ZEALAND: Keith Sandell: (61) 02-9922-2977, FAX (61) 02-9922-1100 JAPAN: Mashy Yoshikawa: (81) 3-3235-5961, FAX (81) 3-3235-5852

AAAS BOARD OF DIRECTORS RETIRING PRESIDENT, CHAIR Peter H. Raven; PRESIDENT Floyd E. Bloom; PRESIDENT-ELECT Mary Ellen Avery; TREASURER David E. Shaw; CHIEF EXECUTIVE OFFICER Alan I. Leshner; BOARD Lewis M. Branscomb; John E. Burris; Nina V. Fedoroff; Karen A. Holbrook; Richard A. Meserve; Norine E. Noonan; Robert C. Richardson; Lydia Villa-Komaroff

Published by the American Association for the Advancement of Science (AAAS), *Science* serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objectives are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

INFORMATION FOR CONTRIBUTORS
See pages 163 and 164 of the 5 April 2002 issue or access www.sciencemag.org/feature/contribinfo/home.shtml



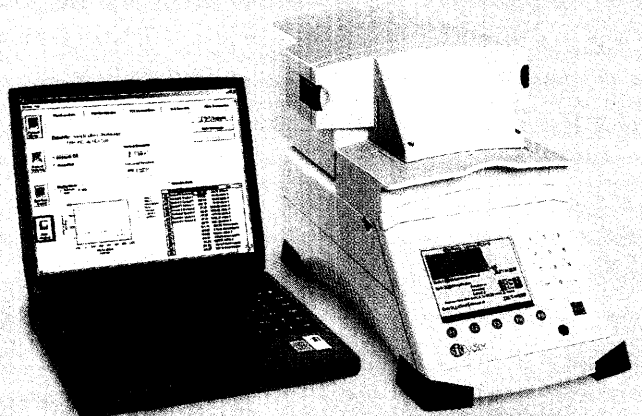
The Search Is Over

New Software
- Automated data analysis
- Intelligent allelic discrimination
- Temperature gradient for assay optimization

New Assay Solutions:
- Real-time PCR certified iQ™ supermix
- Advanced probe and primer design software

Unsurpassed Service:
- On-site, personalized customer support

Find what you're looking for about the iCycler iQ system by visiting our web site at **www.bio-rad.com/iCycler**



Bio-Rad's iCycler iQ System:
Amplify Your Expectations

The polymerase chain reaction (PCR) process is covered by patents owned by Hoffman-LaRoche. Use of the PCR process requires a license.

Visit us on the Web at **discover.bio-rad.com.**
Call toll free at 1-800-4BIORAD (1-800-424-6723);
outside the US, contact your local sales office.

BIO-RAD

READER AND ADVERTISER RESOURCES

Science Careers:

JOB SEARCH

Search job listings by discipline, keyword, location, organization type, and more. Job listings are updated weekly—don't miss out.

Find out more at www.sciencecareers.org.

CAREERS AND EVENTS IN DRUG DISCOVERY

AD SUPPLEMENT IN THIS ISSUE

This report examines the career opportunities available in drug discovery and outlines the background needed for these jobs.

Look for it on page 565.

Product News:

LAB TECHNOLOGY TRENDS

SPECIAL AD SECTION IN THE 10 MAY ISSUE

DNA and Bio Chips II Ready-to-use Microarrays

This section is a continuation of DNA and Bio Chips I, the 4 January 2002 special advertising section. Part 2 will cover the many ready-to-use microarray products available today. Look for it in the 10 May issue.

WWW.SCIENCEPRODUCTLINK.ORG

***Science* Product Link**

Science's online reader service system helps you find information on products advertised in the pages of *Science*. Search by product category, company name, keyword, or page number. Find it all at www.scienceproductlink.org.

Trade Shows & Conferences

LOOK FOR COPIES OF THE 17 MAY ISSUE OF *SCIENCE* AT THESE UPCOMING TRADE SHOWS AND CONFERENCES:

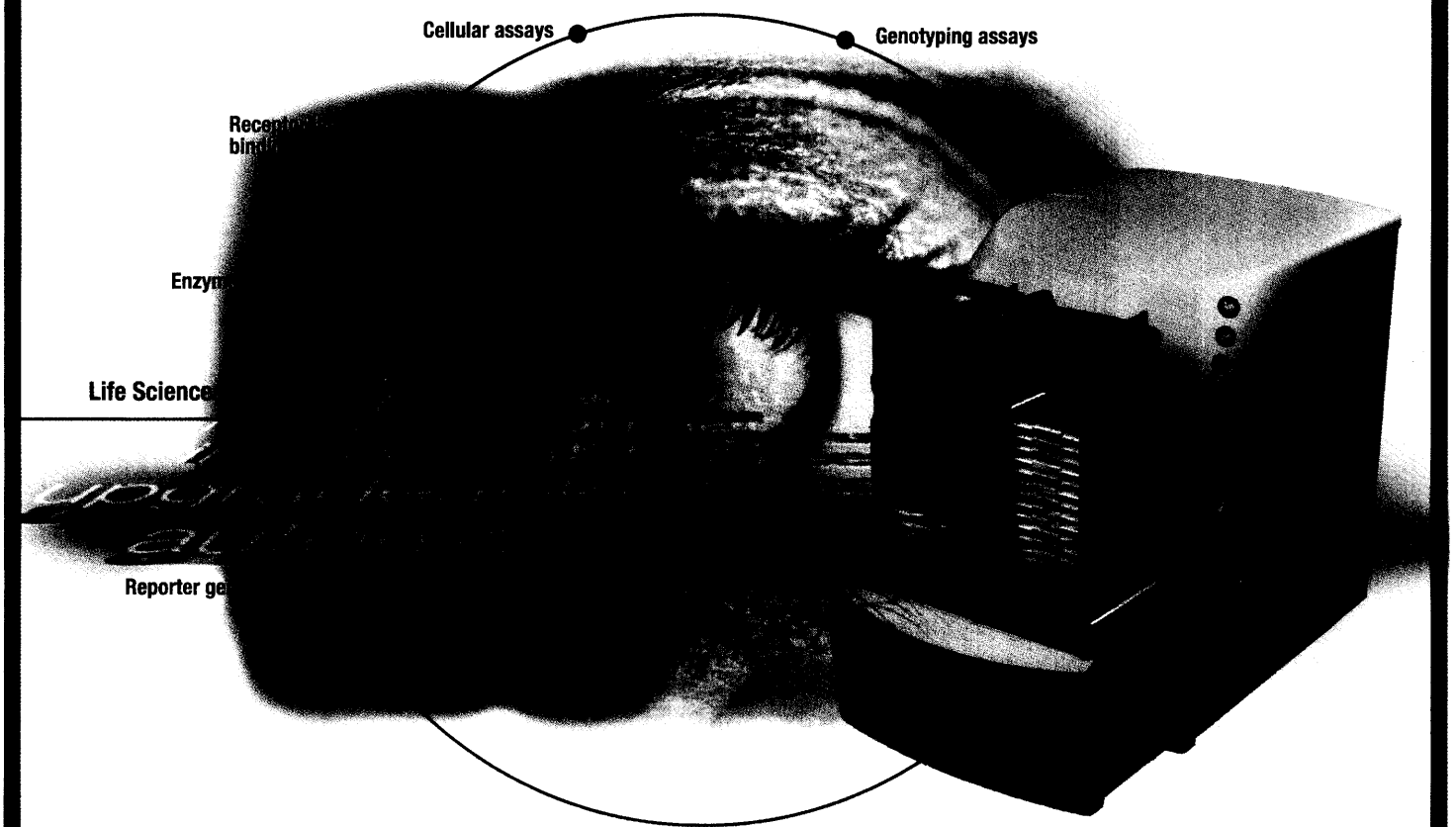
LIGAND RECOGNITION AND MOLECULAR GATING
26–31 May, Barga, Italy (GRC)
GRC–Gordon Research Conferences

AAAS *Science* is published by The American Association for the Advancement of Science. To subscribe to *Science* and become a member of the AAAS, go to **www.aaas.org**.

Drug Discovery | Research | Clinical Screening

High Throughput Screening

EnVision™ faster results



A new plate reading solution
for your chosen applications

Products You Trust

WALLAC

Packard BioScience

EnVision™ is the new application-oriented multilabel plate reader from PerkinElmer Life Sciences. Working with it, you find that your level of achievement is limited only by your own imagination.

Fast detection for superior chemistries

EnVision provides a compact, effective detection solution for all non-radiometric detection technologies including PerkinElmer's LANCE™, DELFIA®, [FP]2™ and SNP chemistries.

- **Modular design allows optimization for specific applications**
- **Accepts all plate formats, and measures a 1536-well plate in under one minute**
- **Supports manual loading or loading from free access stackers**
- **Easy to connect to laboratory automation**

PerkinElmer™
life sciences.

Worldwide Headquarters: PerkinElmer Life Sciences, Inc., 549 Albany Street, Boston, MA 02118-2512 USA (800) 551-2121
European Headquarters: PerkinElmer Life Sciences, Inc., Imperiastraat 8, B-1930 Zaventem Belgium

www.perkinelmer.com/lifesciences

Impressed?
Wait till you see the data.

1µg human total RNA per channel labeled with Submicro Oligo kit

Introducing the first high performance oligo array labeling system. The sensitivity of Genisphere's new 3DNA Submicro Oligo labeling kit is profoundly easy to see. The truth is, it works so well, the results hardly look real. Even more impressive is the quality of the data the kit produces. High end differentials approach 100:1. Results are so reproducible that expression changes as small as 40% are meaningful to a 99% confidence level.* And the Submicro Oligo kit offers a fast, easy protocol and 4-channel detection capability.

We invite you to astound yourself. Call us at **1.877.888.3DNA** or visit us at **www.genisphere.com** to order a sample kit. You won't believe it even in your own lab.

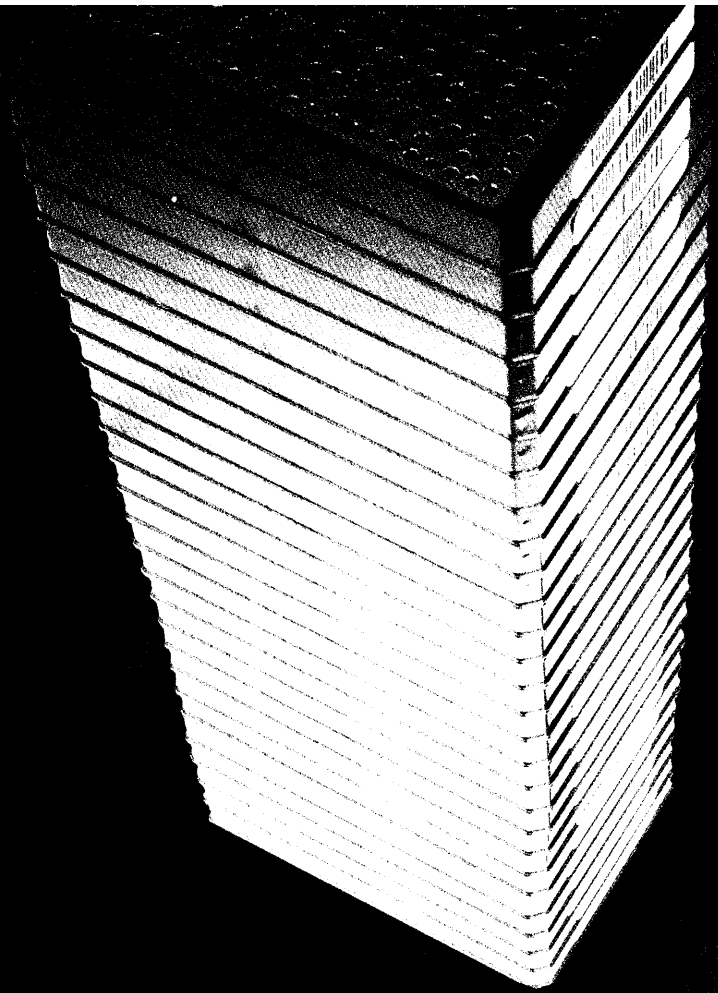
3DNA®

DNA DENDRIMER TECHNOLOGY

* For detailed Submicro Oligo data and data analysis, visit our website at: www.genisphere.com/oligo.html

Genisphere®

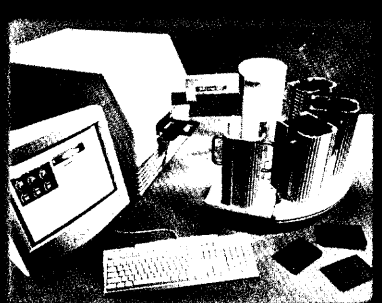
A DATASCOPE COMPANY



Robustness. Flexibility. Accuracy.

Scalability.

5,000 to 500,000 genotypes per day



SNPstream® UHT Genotyping System: SNP genotyping at any scale.

Introducing SNPstream UHT Genotyping System, Orchid's latest addition to its portfolio of SNP genotyping products and services. SNPstream UHT Genotyping System is a complete system that includes automated hardware, software and SNPware™ UHT reagent kits. SNPstream UHT Genotyping System utilizes advanced tag array SNP-IT®, providing a highly accurate yet simple and consistent multiplexing format for any SNP of interest. SNP-IT reactions can be processed in either manual or automated modes, depending on the throughput requirements of the client from the low thousands to over 500,000 genotypes per day.

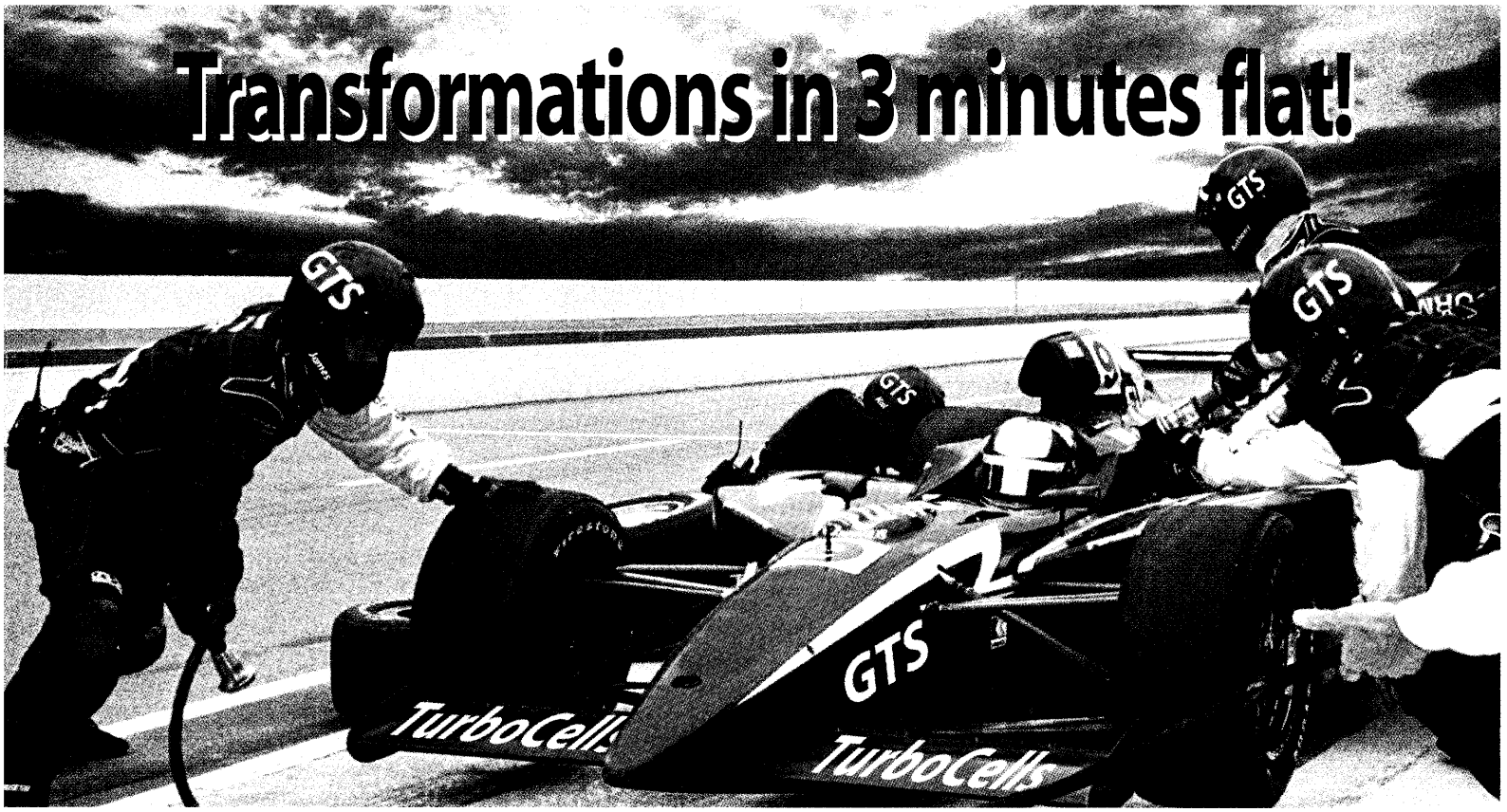
- **Unsurpassed scalability** = from 5,000 to 500,000 genotypes per day
- **Unparalleled Versatility** = one instrument satisfies research scale to industrial scale genotyping
- **Unmatched Accuracy** = Orchid's robust SNP-It technology is the gold standard for SNP scoring
- **Unrivaled Support** = complete system backed up by a team of Application Specialists dedicated to your success

ORCHID

For more information:

Orchid BioSciences, Inc. • 303 College Road East • Princeton, NJ 08540 • 1-609-750-2200 • sales@orchid.com • www.orchid.com

Orchid BioSciences Europe Ltd • 22 Blacklands Way • Abingdon Business Park • Abingdon Oxon • OX14 1DY United Kingdom • +44-1235-535090



Introducing *TurboCells*™ Competent *E. coli*. They work great!

It has been a long day. You are tired and hungry. You just want to go home. But you still have to spend an hour or two to transform competent cells for overnight incubation .....

Sound familiar? That's why we developed TurboCells™ Chemically Competent *E. coli*. They allow efficient transformation in just 3 minutes so you can save hours and still get the colonies you need.

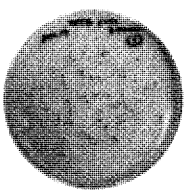
Speed Up Transformation. TurboCells Competent *E. coli* together with TurboCells Buffer are specially optimized to handle the rapid transformation protocol. TurboCells offer:

- **3-minute transformation**
- **No need for hour-long recovery**
- **High transformation efficiency**

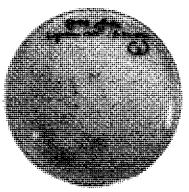
With TurboCells™ Buffer

High Performance. With TurboCells, speed does not mean sacrificing results (see figure). To ensure optimal efficiency, TurboCells are supplied in convenient, single-use 50 µl aliquots. The era of high-speed transformation has arrived. Order TurboCells today and transform your next DNA samples the fast way.

Transformation Results



pUC19 + TurboCells on IPTG/Amp plate



pUC19 self ligation + TurboCells on IPTG/Amp plate

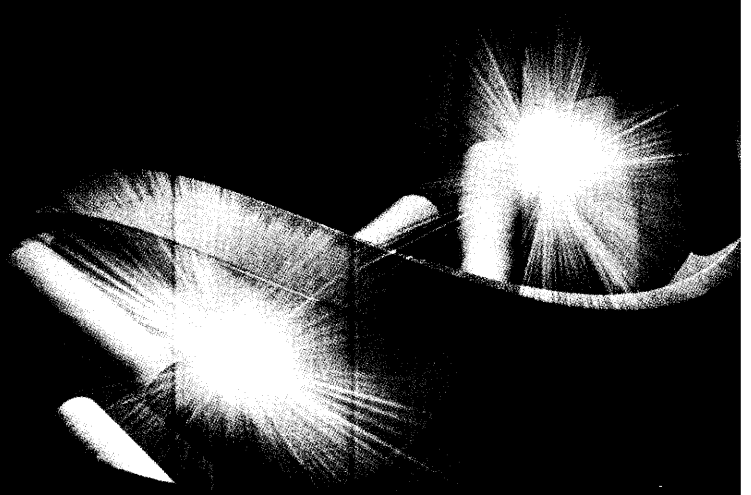
	Quantity	Catalog no.
TurboCells™ Competent *E. coli* with TurboCells Buffer	20 x 50 µl	C300020
TurboCells™ F' Competent *E. coli* with TurboCells Buffer	20 x 50 µl	C301020

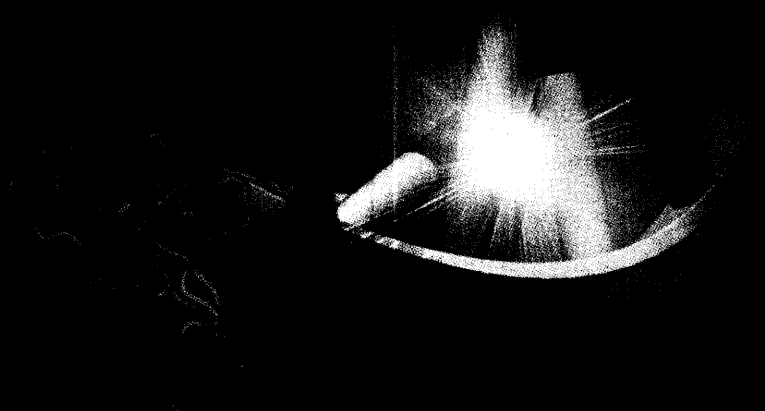
International Distributors
Australia-61-2-9540-2055 or 61-8-9479-5378 Austria-43-1-576-00-328 Canada-905-940-1831 or 613-228-6242 P.R. China-86-21-6441-0501 France-33-1-34602424 or 33-1-45-14-85-80 Germany-49-5152-9020 or 49-9131-610-7020 Hong Kong-852-2649-9988 Israel-97-2-5272-7738 Italy-39-233106630 Japan-81-3-5684-1622 Korea-82-2-841-7530 Netherlands-31-45-532-7755 Singapore-65-97897967 Spain-34-91-551-5403 Sweden-46-8-621-34 00 Switzerland-41-56-484-8080 Taiwan-886-2-2381-0844 United Kingdom-44-1223-31-6855

Tel: 888-428-0558
Fax: 858-623-9494 or 858-558-3617
10190 Telesis Court, San Diego, CA 92121, USA
www.genetherapysystems.com

GTS

SYBR® Green JumpStart™ Taq ReadyMix™





Sigma Lights Your Way To Real Time Quantitative PCR

SYBR Green JumpStart Taq ReadyMix for Quantitative PCR combines the performance enhancements of antibody inactivation for hot start PCR with SYBR Green I in an easy-to-use 2x concentrate.

Sensitive – SYBR Green I detects down to 10 copies of template on the ABI Prism® 7700 Sequencing Detection System.

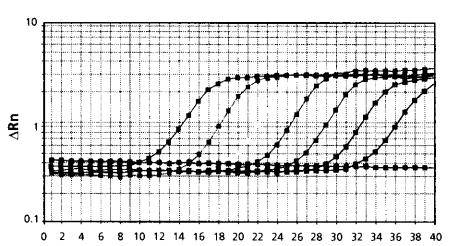
Specific – The hot start mechanism using Sigma's JumpStart Taq antibody prevents non-specific product formation.

Convenient – SYBR Green JumpStart Taq ReadyMix is designed for high-throughput, quantitative PCR applications, providing consistent batch-to-batch and reaction-to-reaction performance.

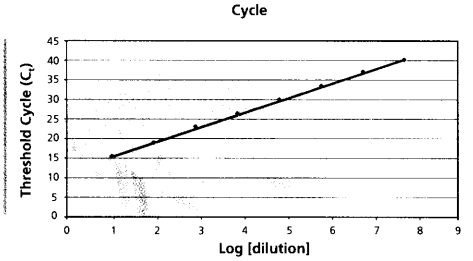
Product Code	Description	Package Size
S 4438	SYBR Green JumpStart Taq ReadyMix	100 reactions
		500 reactions

Threshold cycle (C_T) values for the lambda amplicon using SYBR Green JumpStart Taq ReadyMix

Quantitative PCR (qPCR) performed on pBac-2cp. Initial template copy number was 10^4, diluted 10-fold in subsequent wells. Threshold cycles (Cts) determined using the ABI PRISM 7700 Sequence Detection software.



Linearity of pBac-2cp ten-fold dilutions with SYBR Green JumpStart Taq ReadyMix



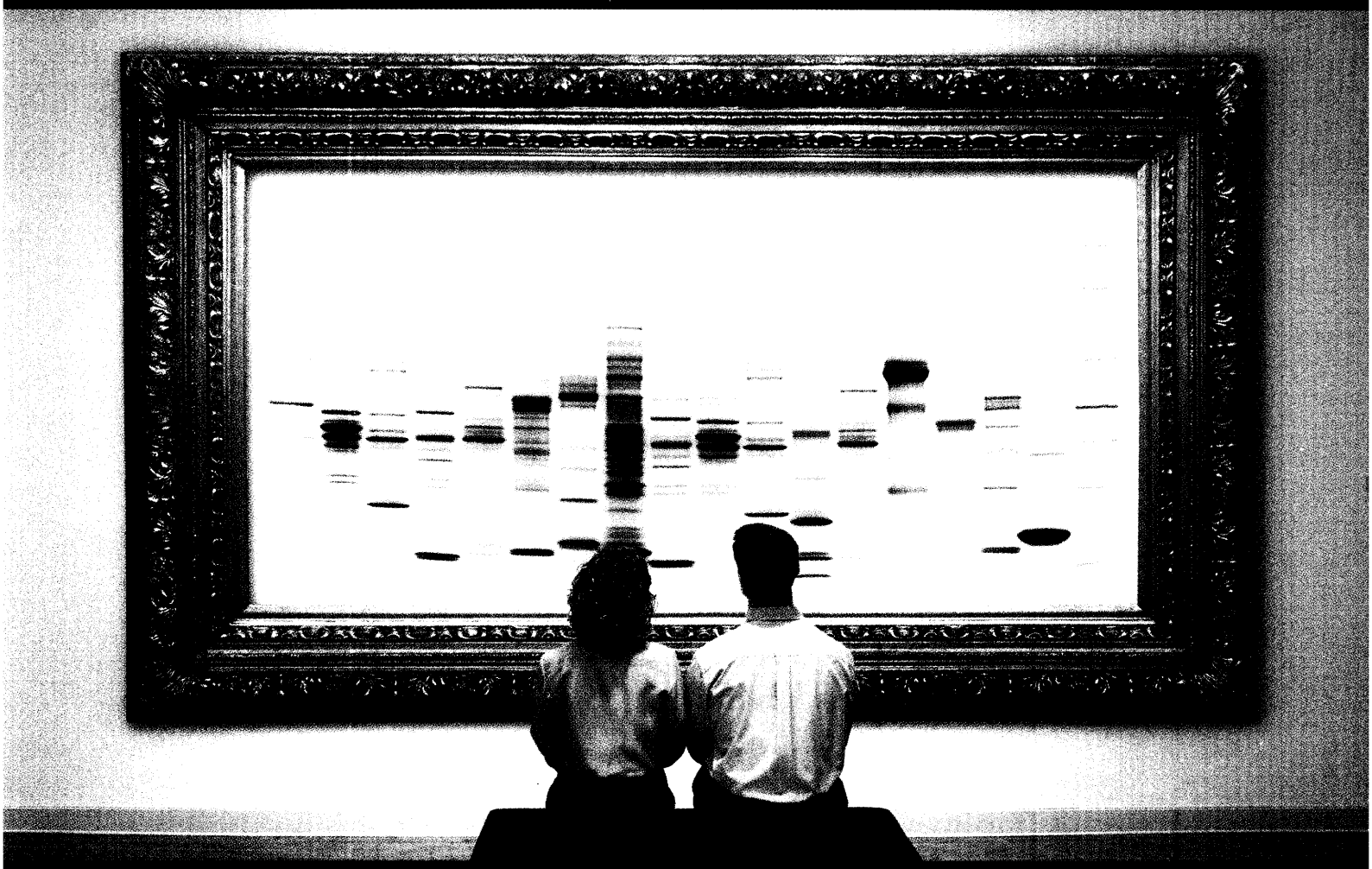
For more information and to evaluate Sigma's Quantitative PCR products, contact us at:
sigma-aldrich.com or call 1-800-718-4328

availability, ordering & tracking
sigma-aldrich.com
scientific tools, products & information

LEADERSHIP IN LIFE SCIENCE, HIGH TECHNOLOGY AND SERVICE
SIGMA-ALDRICH CORPORATION • BOX 14508 • ST. LOUIS • MISSOURI 63178 • USA

SIGMA®

criterion



Masterful Results

Criterion. Advancing the art of precast gel electrophoresis.

For performance that transcends the ordinary, use the system that adds new dimensions to your results: the Criterion precast gel system.

This system will elevate your expectations of throughput. With up to 26 samples on one gel, wells configured for multichannel pipetting, and the Criterion Dodeca™ cell, you can run up to 12 gels in the same time it takes to run two standard gels. That's 312 samples in 55 minutes!

You also get beautiful, sharp separations. The Criterion system is made with the finest materials by the leading manufacturer of precast gels. Criterion delivers consistently high-quality results with every experiment.

What's more, the system offers the quality tools you need to make the most of your talent. There's a broad palette of gels to choose from, and a patented leak-free cassette that makes runs fast and easy. Innovative cell and blotter designs complete the picture.

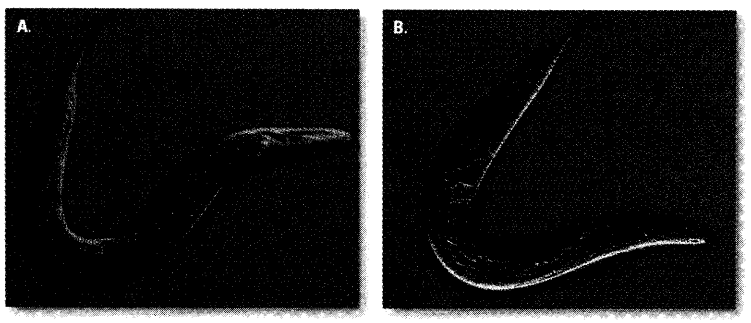
The Criterion precast gel system. You've got to see it to appreciate it. For a private showing, contact your Bio-Rad representative or sign up at criterion.bio-rad.com

Visit us on the Web at **discover.bio-rad.com.**
Call toll free at 1-800-4BIORAD (1-800-424-6723);
outside the US, contact your local sales office.

BIO-RAD

NEW ENGLAND BIOLABS

Savor the silence.



RNAi in *C. elegans*
Fluorescence microscopy of a *C. elegans* adult female with a transgenic GFP reporter gene (green) highly expressed in the pharynx (A). Double-stranded RNA corresponding to the GFP coding region was produced using the HiScribe RNAi Transcription Kit and injected into the syncytial gonad of transgenic adult worms. RNAi is demonstrated by the reduction of GFP expression in the progeny (B).

INTRODUCING THE

HiScribe™ RNAi Transcription Kit

RNA interference (RNAi) is a powerful tool for post-transcriptional gene silencing. Our new HiScribe RNAi Transcription Kit uses cloning vectors with opposing T7 promoters and a single polymerase for high-yield synthesis of double-stranded RNA.

Advantages:

- High-yield (up to 1 mg/ml)
- Double-stranded RNA produced in a single reaction
- Compatible with RNAi protocols in *C. elegans*, *Drosophila* and tissue culture

Ordering Information:

#E2000S Synthesis of up to 2 mg RNA
Kit includes: cloning vectors, primer, polymerase, control template

PRODUCTS YOU TRUST. TECHNICAL INFORMATION YOU NEED. www.neb.com

■ **New England Biolabs Inc.** 32 Tozer Road, Beverly, MA 01915 USA 1-800-NEB-LABS Tel. (978) 927-5054 Fax (978) 921-1350 info@neb.com
■ **Canada** Tel. (800) 387-1095 info@ca.neb.com ■ **Germany** Tel. 0800/246 5227 info@de.neb.com ■ **UK** Tel. (0800) 31 84 86 info@uk.neb.com

NEW ENGLAND BioLabs® Inc.
where science is the priority

DISTRIBUTORS: Argentina (11) 4816-0820; Australia (07) 5594-0299; Belgium (0800)1 9815; Brazil (11) 3622 2320; China 21-6495-1899; Czech Rep. 0800 124683; Denmark (39) 56 20 00; Finland (9) 584-121; France (01) 34 60 24 24; Greece (01) 5226547; Hong Kong 2649-9988; India (044) 220 0066; Israel (3) 9021330; Italy (02) 381951; Japan (03) 5820-9408; Korea (02) 556-0311; Mexico (5) 525 5725; Netherlands (033) 495 00 94; Norway 23 17 60 00; Singapore 4457927; Spain (93) 401.02.10; Sweden (08) 30 60 10; Switzerland (061) 486 80 80; Taiwan (02) 28802913

TaKaRa

Rapid New Gene Discovery in Functional Genomics with Combinatorial Microarrays

TaKaRa Provides Customized Microarrays that Combine Conventional DNA Microarray Technology with Lynx's Innovative Cloning on Micro-beads.

Unique Custom Microarray Services Only from TaKaRa Utilizing Next-Generation Technologies

A comparative sample set of tissues or cells is all that is required for customized DNA microarrays.

Using MEGACLONE™, innovative micro-beads technology, essentially all of the sample DNA molecules are captured and cloned on millions of micro-beads.

MEGASORT™, or "fluid" micro-array based on micro-beads, delivers focused sets of differentially expressed genes and targets of your research interest including both known and unknown.

Discrete spots of cDNA arrays are laid onto proprietary solid glass slides that heighten S/N ratio significantly and custom designed to rapidly advance discovery and development of genetic functions.

* *MEGACLONE™ and MEGASORT™ are licensed from LYNX.*

* *References:*

1) Nat. Biotechnol. **18**, *630-634 (2000)*

2) Proc. Natl. Acad. Sci. USA **97**, *1665-1670 (2000)*

For More Information on these and other comprehensive services. Contact us at **bio-sm@takara-bio.co.jp**

High-Quality Pre-Spotted Microarray CHIPs for Expression Profiling with Reliability and Reproducibility

One slide contains well-characterized and known genes from specific pathways or relevant groups with positive and negative controls for normalization.

IntelliGene™ DNA Microarray Series*

IntelliGene [2] Human Cancer CHIP
IntelliGene [1] Human Cytokine CHIP
IntelliGene [3] Rat Toxicology CHIP
IntelliGene [3] Human CHIP 1K Set I
IntelliGene [1] Mouse CHIP Set I
IntelliGene [3] CyanoCHIP
IntelliGene [1] Arabidopsis CHIP I
IntelliGene [1] *E. coli* CHIP
IntelliGene [1] TestARRAY

* *TaKaRa's IntelliGene™ DNA Microarray Series are licensed from Affymetrix.*

Visit our website for more details including Gene Lists.
(**www.takara-bio.co.jp/**) or
(**www.takara-bio.co.jp/english/bio_e/products/pro10.htm**)

TAKARA BIO INC.
The Biotechnology Company™

Otsu, Shiga, Japan
Phone:+81 77-543-7247 Fax:+81 77-543-9254
Homepage: http://www.takara-bio.co.jp
E-mail: bio-sm@takara-bio.co.jp

Korea: **Takara Korea Biomedical Inc.** Phone: (02) 577-2002 Fax: (02) 577-3691
China: **TaKaRa Biotechnology (Dalian) Co., Ltd.** Phone: (0411) 763-2792 Fax: (0411) 761-9946
Europe: **TaKaRa Biomedical Europe S.A.** Phone: +33 1 41 47 23 70 Fax: +33 1 41 47 23 71

DISTRIBUTORS

USA and the Americas: **PanVera Corporation** Phone: 800 791 1400 Fax: 608 204 5000 E-mail: info@panvera.com

USA: **Fisher Scientific** Phone: 800 766 7000 Fax: 800 926 1166

Europe: **BioWhittaker Europe** Austria: 0800 201 538 Belgium: +32 87 321 611 France: 0800 911 981 Germany: 0800 182 5287 Netherlands: 0800 022 4525 Switzerland: 0800 838 620 UK: +44 118 979 5234

Taiwan: **Cheng Chin Trading Co., Ltd.** Phone: +886 2 2331 3111 Fax: +886 2 2382 2197
Cold Spring Biotech Co., Ltd. Phone: +886 2 2695 9990 Fax: +886 2 2695 9963

Novartis and Suzan drove her into remission in 35 days.

"One minute I was looking at death.

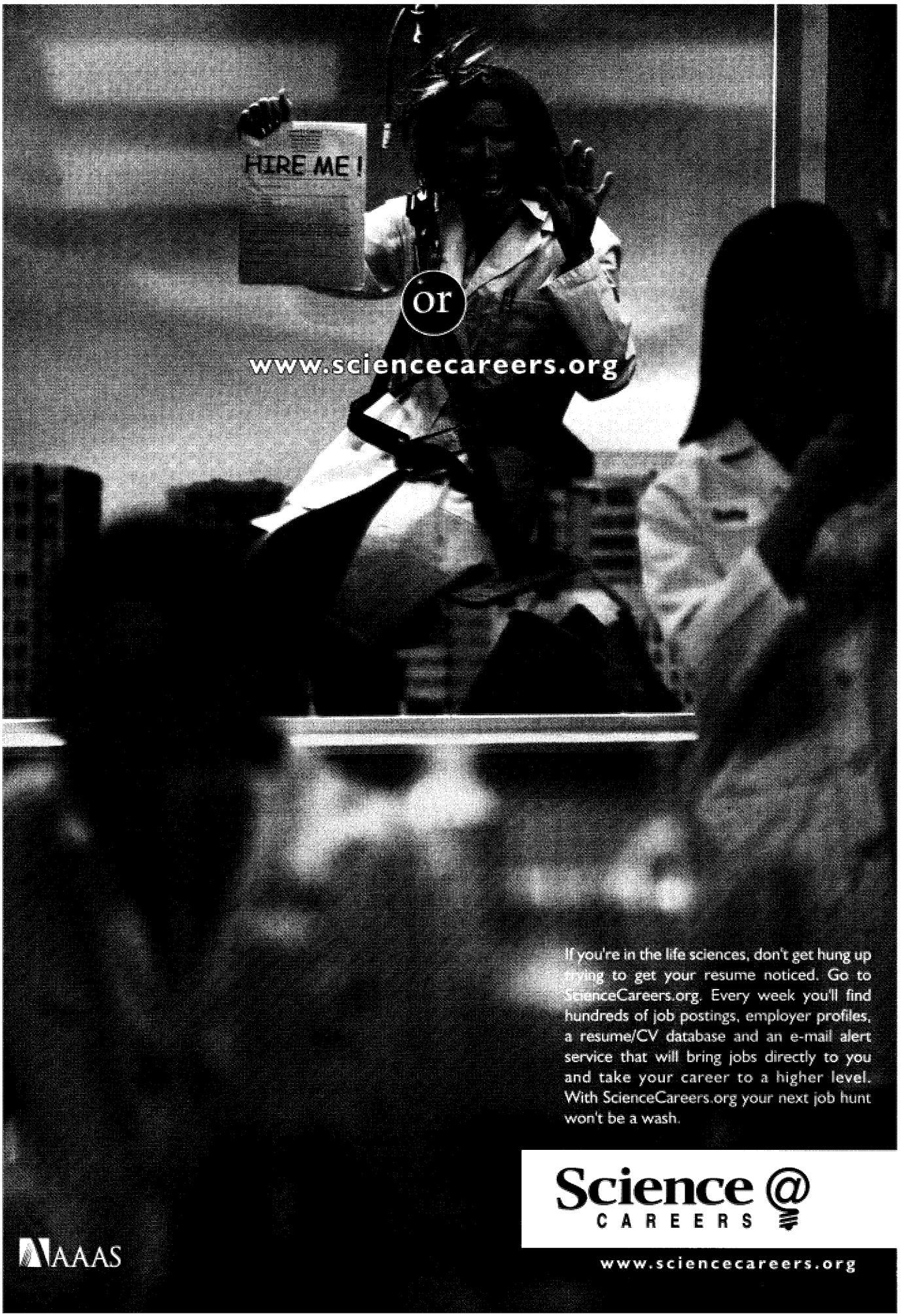
— Suzan M.

Suzan had been fighting a losing battle against cancer for three long years. By January 2000, she was too sick to continue her studies. She was losing weight, her hair, and at times, her will to live. But today Suzan feels better than ever. And as a result of her experience, she's now pursuing a new degree, and a new career, in molecular biology. Novartis is proud to be the innovative force that's bringing new optimism and hope to patients and their families. No one can promise what the future holds for cancer patients, but today Suzan is winning the fight against her particular form of cancer, enjoying a good quality of life and realizing her dreams.

Think what's possible.

NOVARTIS

www.novartis.com

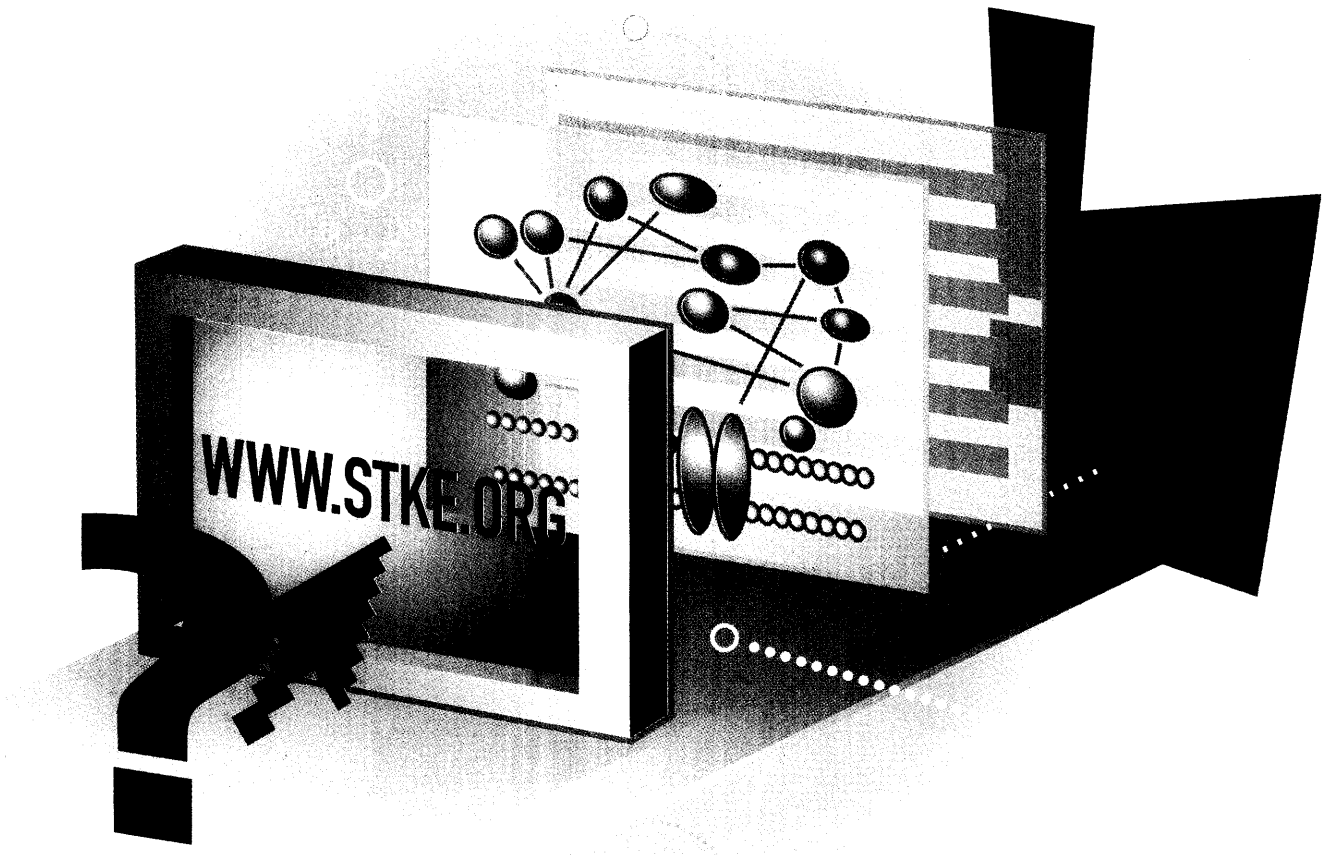


If you're in the life sciences, don't get hung up [illegible] to get your resume noticed. Go to ScienceCareers.org. Every week you'll find hundreds of job postings, employer profiles, a resume/CV database and an e-mail alert service that will bring jobs directly to you and take your career to a higher level. With ScienceCareers.org your next job hunt won't be a wash.

Science @ CAREERS

AAAS

www.sciencecareers.org



STKE PUTS YOU ON THE RIGHT PATH

Updated weekly, *Science*'s *Signal Transduction Knowledge Environment* (*STKE*) provides the perfect combination of quick summaries and full text access to research papers from over 40 respected scientific journals, plus original *Reviews*, *Protocols*, and *Perspectives*.

You'll also find a Connections Map database of signaling molecules, plus an extended list of helpful e-tools like *personalization options* and *interactive* letters, all at www.stke.org.

To subscribe to *STKE*, or for more information, visit *STKE* at www.stke.org and click *subscriptions*, or contact AAAS at (202) 326-6417 or membership2@aaas.org.

No one can know where new insights in signal transduction might lead you, but *STKE* will help you find the right path.

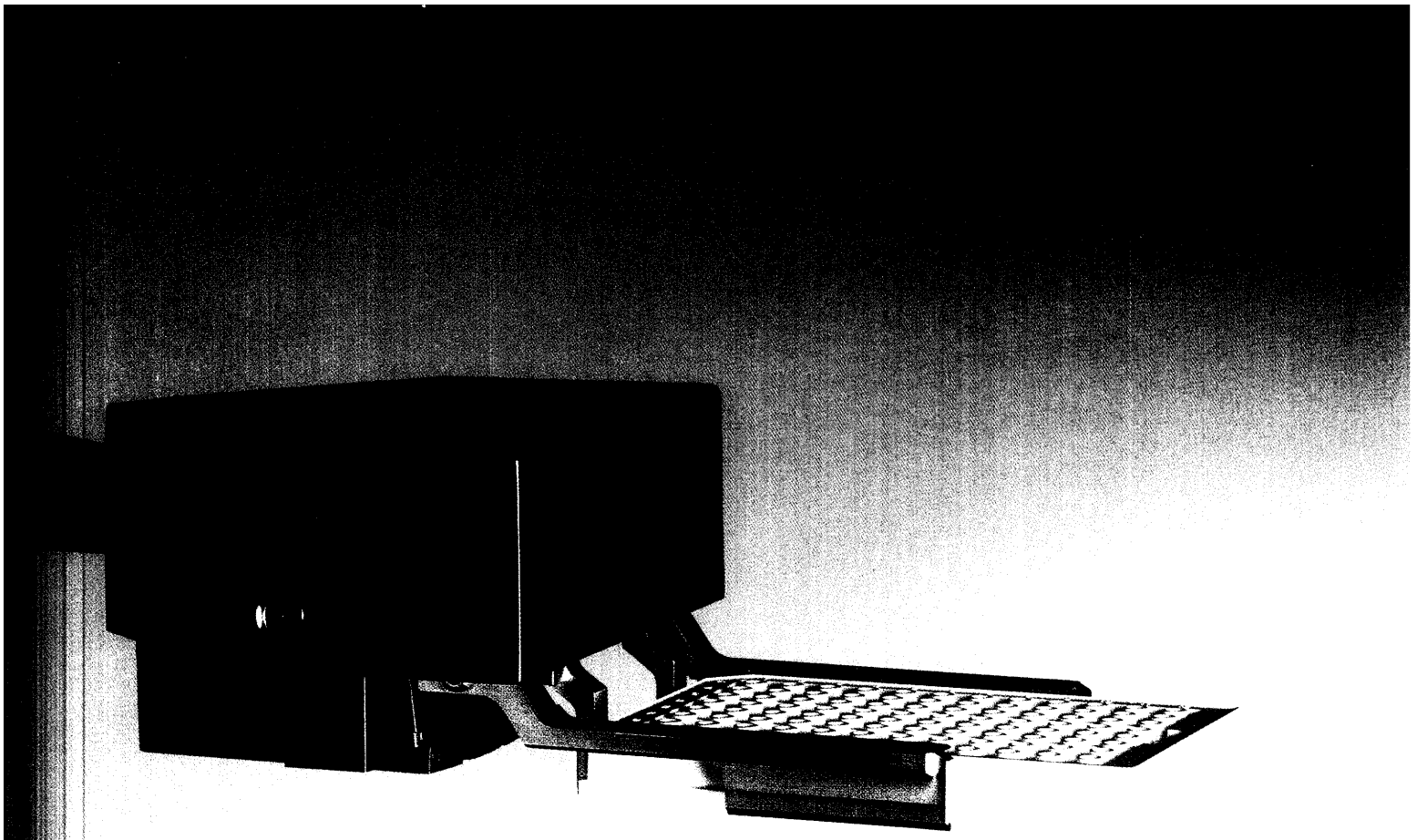
Science's stke

You're on the right path™

SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

a product of *Science* and Stanford University Libraries

www.stke.org



AN ARM

NEED ~~A HAND~~ WITH SNP AND MUTATION ANALYSIS?

If you are looking for a fast, accurate and **cost-efficient** solution for SNP and mutation analysis, you should be looking at the new PSQ™ HS 96A. Based on proven Pyrosequencing™ technology, it is ideal for medium to **high throughput** genotyping needs.

A mechanical arm that feeds the system with 96-well plates is coupled with automatic analysis software, allowing **unattended operation**. More importantly, Pyrosequencing technology assures you accurate and reliable results.

The PSQ HS 96A is based on a high sensitivity platform that minimizes the amount of samples and reagents required. In addition, the system uses sequence context information to generate quality assessed, unambiguous data, eliminating the need to run replicates. **Multiplexing**, as well as pooling for **allele frequency** quantification, can increase cost efficiency still further. So, if your focus is on cost per **accurate result**, look no further.

To find out how Pyrosequencing can give your SNP and mutation analysis a hand, visit **www.pyrosequencing.com**

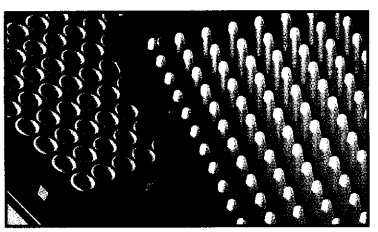
PYROSEQUENCING

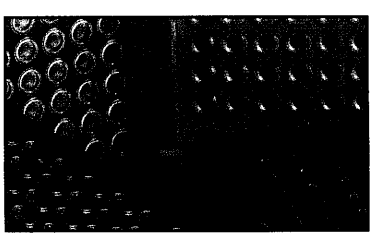
A new light on DNA

Ready for a New Shell?

Hard-Shell™ Thin-Wall

- Novel two-component molding process eliminates plate warp & shrink during thermal cycling – a common problem with standard polypropylene plates.
- Flat, warp-free plates mean accurate, low-volume pipetting – with several options for tight sealing.
- Rigid skirt & deck – ensures reliable handling in robotic arms and plate stackers.





- Thin-wall polypropylene V-wells give efficient thermal transfer & maximal recovery of low-volume samples.
- Color code your assays – and still enjoy the convenience of clear wells.
- Ideal for optical assays – signals read consistently because plates remain flat.

Choose clear, white or black wells for optimal performance in your assay.

Hard-Shell™
Thin-Wall
96-Well Microplates Patent pending

Optimized for Automation & Thermal Cycling

MJ Research
INCORPORATED

(888) 729-2164 ◆ info@mjr.com ◆ www.mjr.com

Boston ◆ San Francisco ◆ Tahoe ◆ Copenhagen ◆ Seoul

REAL TIME PCR...
I CAN afford it.

The Smart Cycler System is within reach — and you don't have to compromise on performance.

The Smart Cycler gives you rapid cycling and real-time PCR in a flexible, reliable benchtop format that expands your lab's capabilities:

Fast processing times. Results in as little as 20 minutes due to rapid, accurate heating and cooling cycles with patented I-CORE technology.

Increased lab productivity. The only system that allows multiple users and multiple protocols at the same time.

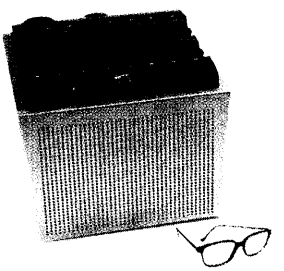
Multiplexing capability. Detect up to four targets in one sample with real-time, four-channel fluorometric detection.

Maximize your lab budget. The Smart Cycler System's reasonable cost and easy expansion capabilities save budget dollars.

SmartCycler®

A FLEXIBLE AND EXPANDABLE REAL TIME THERMAL CYCLER

WWW.SMARTCYCLER.COM



Sixteen independently-programmable I-CORE® modules comprise each Smart Cycler processing block. Up to 6 blocks can be interconnected as your workload increases.

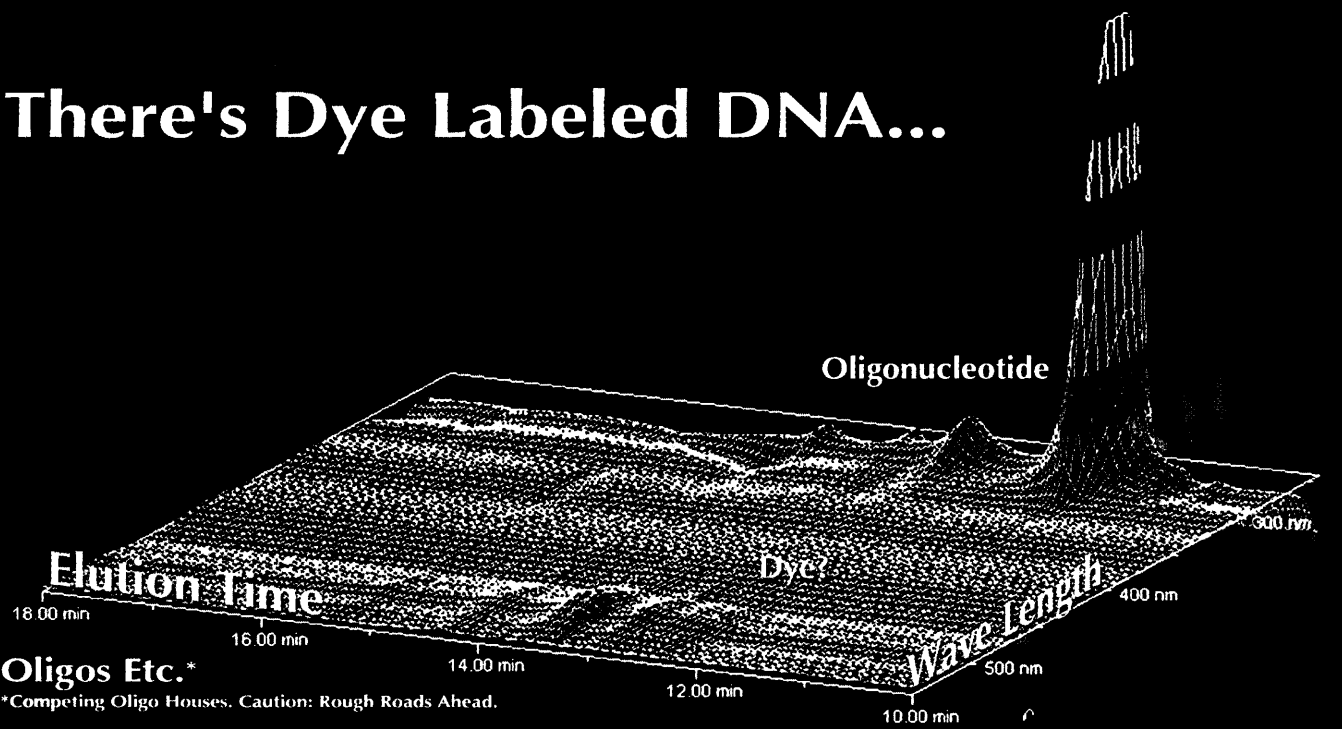
Cepheid

888.838.3222

Fisher Scientific

Practice of the patented polymerase chain reaction (PCR) process requires a license. The Smart Cycler System is an Authorized Thermal Cycler and may be used with PCR licenses available from Applied Biosystems. Its use with Authorized Reagents also provides a limited PCR license in accordance with the label rights accompanying such reagents. Purchase of this instrument does not convey any right to practice the 5' nuclease assay or any of the other real-time methods covered by patents owned by Roche or Applied Biosystems.

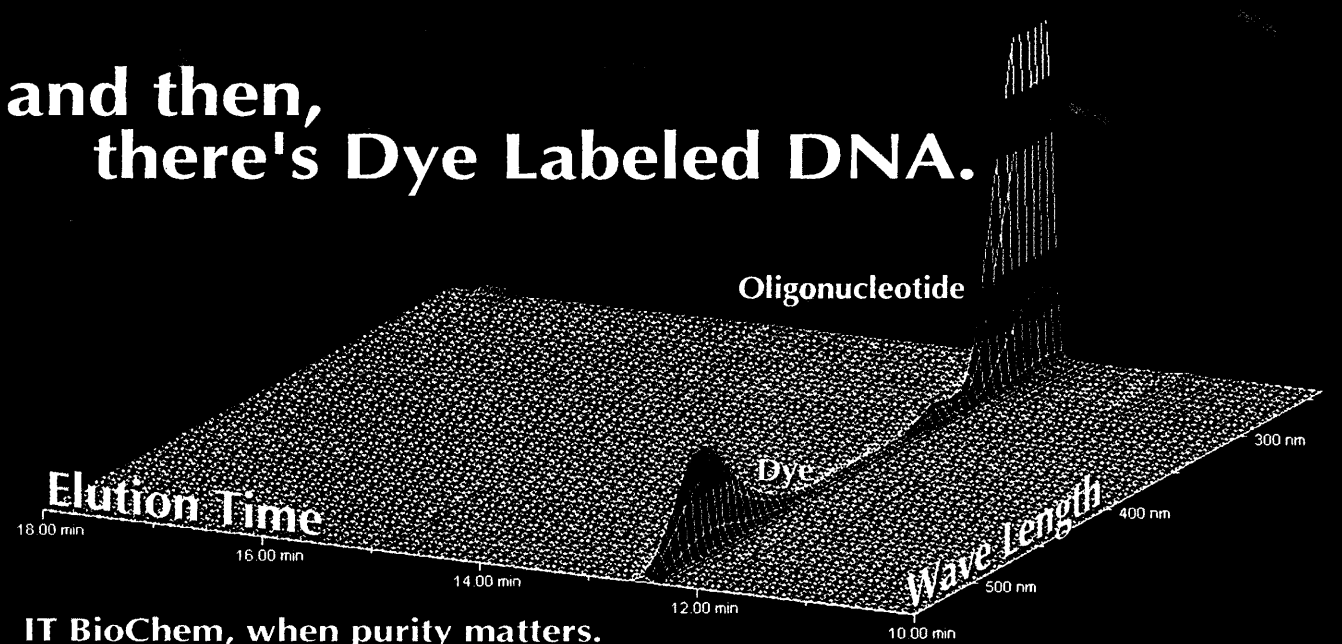
There's Dye Labeled DNA...



Oligos Etc.*

*Competing Oligo Houses. Caution: Rough Roads Ahead.

and then, there's Dye Labeled DNA.



IT BioChem, when purity matters.

BioChem
A DIVISION OF IDAHO TECHNOLOGY INC.

390 Wakara Way, Salt Lake City, Utah 84108 / USA
1-800-735-6544 / ph. (801) 736-6354 / fax (801) 588-0507
it@idahotech.com / www.idahotech.com

LightCycler® Technology