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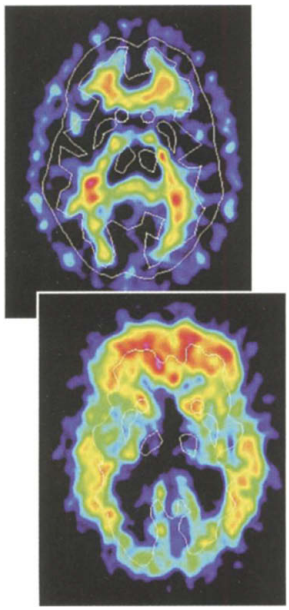
# Science

Volume 297 2 August 2002 Number 5582



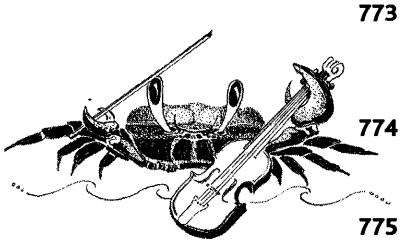
**752**
Early marker for Alzheimer's

## NEWS



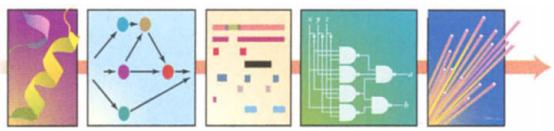
## *SCIENCE*'S COMPASS





**774**
Organisms keeping time

**784**
Statistical physics meets computer science

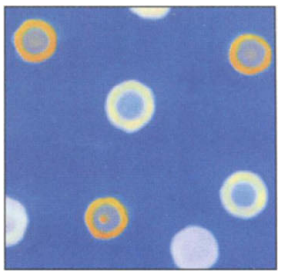


# GREEN CHEMISTRY



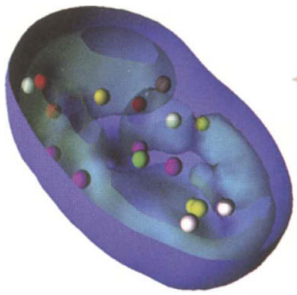
# RESEARCH



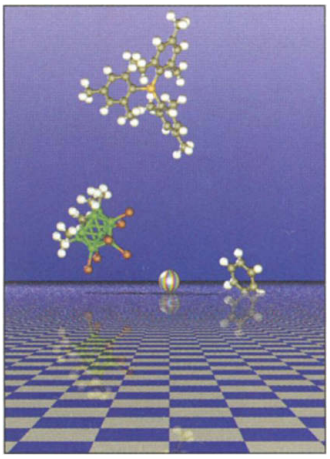


## COVER 815

Normal and mutant strains of *Neurospora crassa*, a fungus that normally produces orange carotenoids (thought to provide protection from ultraviolet rays) in response to light. Deletion of the photoreceptor White Collar–1 blinds the fungus so that it fails to produce carotenoids, resulting in a white appearance. Loss of Vivid protein, a repressor of light-regulated processes, results in carotenoid overproduction and intense orange coloration. [Image: C. Heintzen and A. Froehlich]

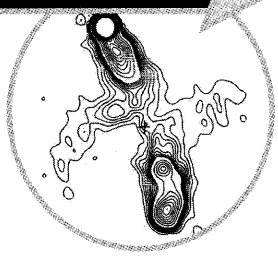


**836**
Viewing transcription in a single cell



**825**
Stable and free silylium ions

**New on *Science* Express** Merging black holes

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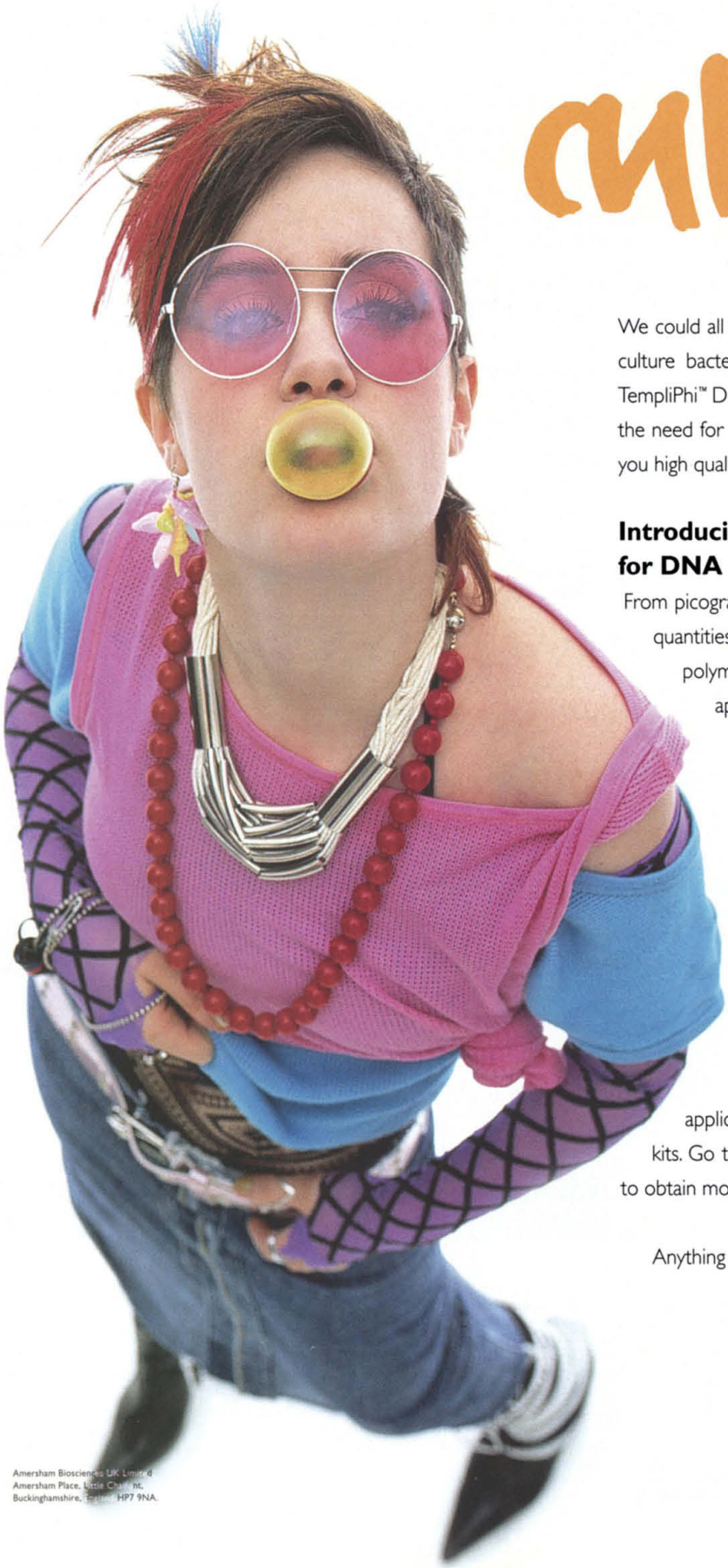

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CONTENT HIGHLIGHTS AS OF 2 AUGUST 2002

## science magazine www.sciencemag.org

### *SCIENCE* EXPRESS www.sciencexpress.org

**Structure of the Extracellular Region of HER3 Reveals an Interdomain Tether** H.-S. Cho and D. J. Leahy

The structure of the extracellular portion of an epidermal growth factor receptor reveals a wide-open binding site—too open, in fact.

**Tracing Black Hole Mergers Through Radio Lobe Morphology** D. Merritt and R. D. Ekers

753 Crossed radio lobes from jets are due to the merger of two black holes; such mergers provide a source of gravitational waves.

**A MicroRNA in a Multiple-Turnover RNAi Enzyme Complex** G. Hutvágner and P. D. Zamore

Complementarity defines whether small RNAs generated by the Dicer enzyme function as microRNAs or small interfering RNAs.

### TECHNICAL COMMENTS

**Mantophasmatodea: A New Insect Order?**

Klass *et al.* (Reports, 24 May 2002, p. 1456) described a new extant insect order, Mantophasmatodea, on the basis of two museum specimens from Africa. After performing systematic anatomical analysis, they proposed that the new insects were related to but distinct from phasmids, or stick insects. Tilgner, in a comment, argues that "these insects are instead aberrant members of the order Orthoptera, which also includes . . . crickets and katydids . . . and grasshoppers," and he stresses that formal phylogenetic analysis is required before claiming existence of a new insect taxon. In response, Klass notes that "composing meaningful [insect character] matrices will take years of diligent morphological studies" and argues that careful analysis of physical characteristics such as tarsal and intervalvular structure clearly excludes Mantophasmatodea from Orthoptera, based on current understanding of what traits specify known insect orders.

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/297/5582/731a

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## science's next wave www.nextwave.org

career resources for scientists

**GLOBAL: Careers in Complementary and Alternative Medicine** Edited by J. Wong

From researchers to practitioners, doctors and scientists worldwide are reexamining traditional remedies.

**UK: Engineering or Academia? The Best of Both, Please!** C. Reid

Our essayist quickly realized he was not meant to be a captain of industry, but he still found a way to enjoy engineering.

**GERMANY: Interim Data from the Junior Professor Experiment** S. Steghaus-Kovac

As the first junior professors are being appointed, Next Wave takes an empirical look at the new model.

**US: A Brief Guide to the Universe of Postdocs** L. Haak

Here it is: a thorough revamp of the popular and ever-useful Postdoc Network database of postdoc organizations.

**GRANTSNET: August's Biomedical Funding News** K. Cottingham

Stories on grants for alternative medicine, funds for underrepresented investigators, and the latest biomedical funding news.

### KNOWLEDGE ENVIRONMENTS

## science's sage ke www.sageke.org

science of aging knowledge environment

**Noteworthy This Week: Up All Night** R. J. Davenport

Aging disconnects body's timepieces.

**Noteworthy This Week: Knot the Whole Story** M. Leslie

Study snags new source of plaque ingredient.

**Noteworthy This Week: Gauging Aging** M. Beckman

Microscopy separates rapidly aging worms from the merely sick.

## science's stke www.stke.org

signal transduction knowledge environment

**Perspective: CD28 Costimulation—A Source of Vav-1 for TCR Signaling with the Help of SLP-76?** F. Michel and O. Acuto

Vav-1 recruited by CD28 and SLP-76 recruited by the TCR synergize to produce functional T cell activation.

**Protocol: Measuring Peptide Secretion Using the FMRFamide Tagging Technique** M. D. Whim

Detailed methods for using an invertebrate ligand-gated channel as a reporter for secretory events.




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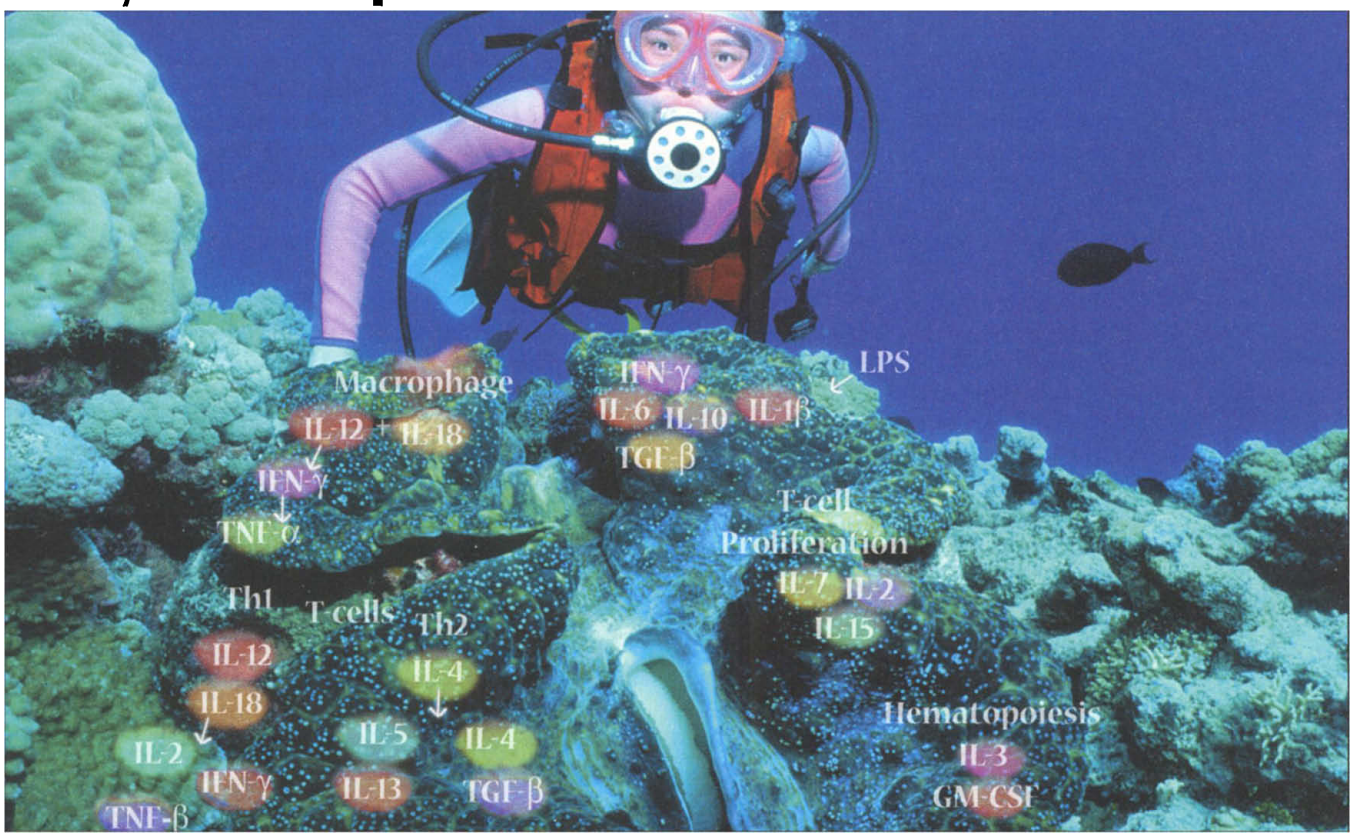


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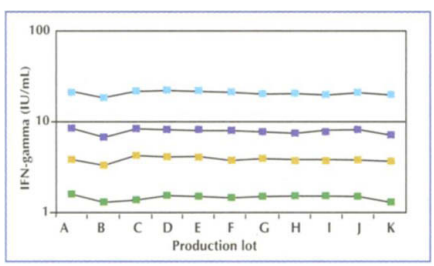


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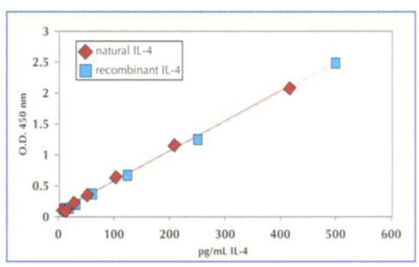


*Parallelism: Monkey IL-4 ELISA (Cat. #KPC0041).*

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# THIS WEEK IN Science

edited by Phil Szuromi

## Satisfaction Guaranteed?

Search problems ranging from scheduling to protein folding can usually be recast as K-satisfiability (Ksat) problems, in which one tries to determine if a solution exists for $M$ constraints between $N$ Boolean variables, where each constraint is a logical OR clause over $K$ variables. Such Ksat problems for $K > 2$ belong to the large family (>10,000) of computationally hard NP-complete problems. Mézard *et al.* (p. 812; see the Perspective by Gomes and Selman) blend ideas of computer science and statistical physics to introduce an algorithm for evaluating such computationally hard problems. They present a phase diagram in terms of the ratio of clauses to variables and show there are critical values separating problems that can be satisfied from those that cannot. For those near the boundary, characterization of the behavior of the problem not only can tell whether a solution exists, but also give an indication of just how long it may take to find solutions.

## Fast Finish for Photoproducts

The photoisomerization reaction in bacteriorhodopsin has become a model system for understanding the light-induced isomerization reactions of this class of proteins. A fundamental issue is the speed at which the 13-cis product forms. Ultrafast optical spectroscopy has indicated that this cis product forms during the rapid formation (about 500 femtoseconds) of the ground electronic state, but other studies argue that isomerization occurs during later relaxation steps. Herbst *et al.* (p. 822) now present ultrafast midinfrared spectroscopic experiments, which probe the C-C, C=C, and C=NH vibrational modes, that show the direct formation of the cis product within 500 femtoseconds.

## Shifting the Weight of Earth

One component of Earth's gravity field, called $J_2$, provides a measure of the oblateness of the planet. Since 1980, $J_2$ has been decreasing, primarily due to postglacial rebound effects on mass distribution in the mantle. Cox and Chao (p. 831; see the Perspective by Cazenave and Nerem) combined data from nine satellites over 25 years to estimate $J_2$ and found that $J_2$ increased rather sharply in 1998. Although global sea level change or variations in glacial ice melting rate were modeled as possible causes, neither effect is significant enough to account for the changes in $J_2$. Instead, a large mass redistribution may have occurred at the core-mantle boundary driven by material flow in the liquid iron outer core.

## 820 Increasing Light at the End of the Tunnel

The transmission of light through an aperture is strongly suppressed as the size of the hole starts to approach the wavelength of the light. The light that does make it through is strongly diffracted and emitted over a semispherical surface. Lezec *et al.* (p. 820) show that surrounding an aperture on the incident and exit sides with a periodic pattern can enhance transmission and sharpen directionality. This effect should prove useful in near-field optics requiring small light sources.

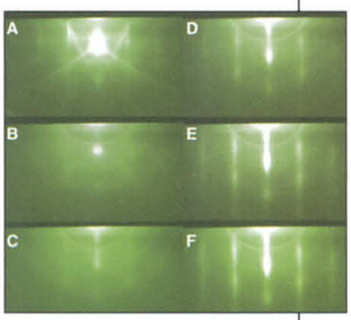
### And in Brevia ...

In a study by Roth *et al.* (p. 811), changes in metabolism have been seen in long-lived men that are similar to those identified in calorie-restricted mice.

## Free Silylium at Last?

Carbocations ($R_3C^+$), where R is hydrogen or alkyl or aryl groups, readily exist in solution. The analogous silylium ions, $R_3Si^+$, have been seen in the gas phase, but evidence for their existence in condensed phases, especially when R is an alkyl group, has so far been unconvincing. Kim *et al.* (p. 825; see the Perspective by Gaspar) now show that when aromatic mesityl groups are the substituents and a noncoordinating boron anion is used, crystals can be grown from benzene solution. The structure from x-ray diffraction provides direct evidence for noninteracting $R_3Si^+$, and the crystals exhibit the same Si chemical shift as the species in solution.

## The Layered Look




Growing metal overlayers on oxide substrates is a tricky process because the thermodynamics of the surface layer favors aggregation and the formation of separated clusters. Chambers *et al.* (p. 827) show that cobalt layers can be grown on sapphire (α–aluminum oxide) if the substrate is first hydroxylated. The first layer of Co atoms that deposit on the surface oxidize; subsequently arriving atoms then bind to the top of this oxide layer. This anchoring then supports uniform layer growth.

CREDIT: CHAMBERS *ET AL.*

## Elements of a Fungal Light Receptor

The fungus *Neurospora crassa* is a light-sensitive organism, but its photoreceptor has remained elusive. The prime candidate, a transcription factor called White Collar–1 (WC-1), is required for all responses to light (see the Perspective by Linden). By eliminating the part of the WC-1 protein that would be expected to bind a chromophore (the LOV, or light, oxygen, or voltage, domain), He *et al.* (p. 840) show that the LOV domain is required for light responses but not for the circadian clock function of WC-1. They then identify flavin adenine dinucleotide (FAD) as the chromophore bound to WC-1. Froehlich *et al.* (p. 815) show that WC-1 acts (as a dimer with WC-2) on two light-responsive elements in the promoter of the clock component frequency (frq). By reassembling this system in vitro and inducing frq transcription with light, these authors show that WC-1 is the blue light photoreceptor for *Neurospora*. In their system as well, FAD must be added in order to observe light reception.

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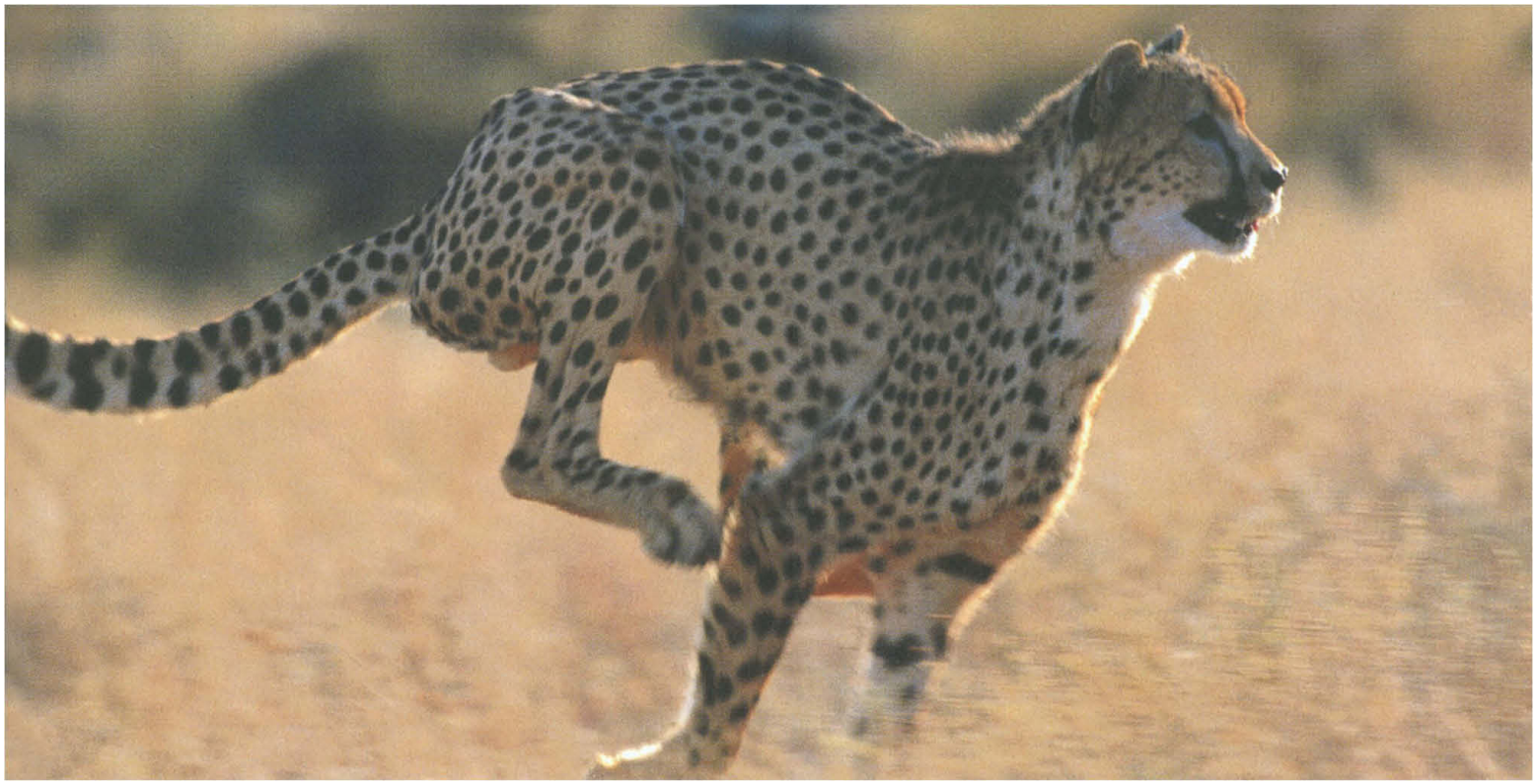

**Cheetah** *(Acinonyx jubatus)*

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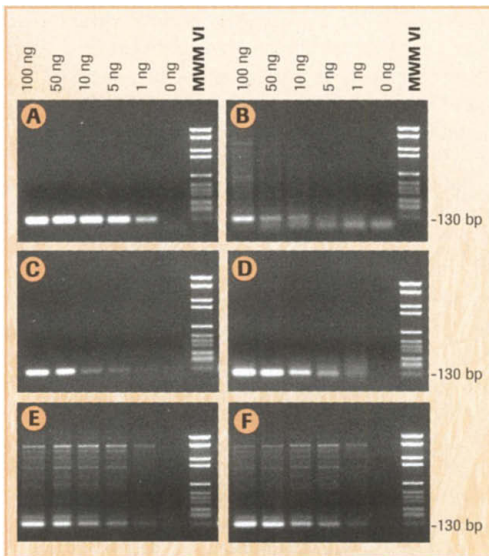


**Figure 1: Specificity and sensitivity comparison in PCR using commercially available hot start systems.**

Various amounts of human genomic DNA were used for the amplification of a single 130 bp fragment from the tissue plasminogen activator (tPA) gene. Manufacturers' recommended initial product-activation times were used when applicable. The following cycling conditions were used in all reactions:

35 cycles at:
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- 60°C for 30 seconds
- 72°C for 60 seconds

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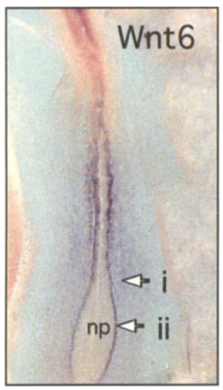
## The Fire of Life

Why do some people gain weight readily and others stay lean no matter what they eat? An old hypothesis attributes this to interindividual variability in diet-induced thermogenesis (DIT), the heat generated in response to food ingestion. DIT is thought to be mediated by the sympathetic nervous system and stimulation of β-adrenergic receptors (βARs) on thermogenically active target tissues. Bachman *et al.* (p. 843; see the Perspective by Dulloo) have now tested this hypothesis by generating mice that lack the three known βARs, a genetic manipulation that should incapacitate DIT. These mutant mice become massively obese when placed on a high-fat diet. Thus, at least in rodents, DIT is indeed an important component of the body's defense against obesity. Whether defects in DIT can explain human obesity remains to be seen.

## Representing Someone Else's Actions

How did the complex trait of language evolve, and how widespread is it in our closest relatives in the animal kingdom? To gain insight into the neural basis of language in humans, Kohler *et al.* (p. 846) recorded from neurons in the ventral premotor cortex of monkeys. This region corresponds to the location of Broca's area in humans, one of the most important brain regions for speech production. Neurons responded when the monkey performed specific motor acts, when the monkey observed other animals performing the same act, and also when it heard the same act being performed out of sight. These so-called mirror neurons may be a key to understanding the origins of abstract communication.




CREDIT: GARCÍA-CASTRO

## Different Ascents on Neural Crest Cells

Neural crest cells arise in vertebrates at the junction between the developing neural tube and the surrounding ectoderm. These cells have particularly divergent fates, as they contribute to peripheral nerves, pigment cells, and cartilage in the head and neck. García-Castro *et al.* (p. 848; see the Perspective by Trainor and Krumlauf) found that Wnt signaling is critical for inducing development of neural crest cells in the chick. BMP (bone morphogenetic protein) signaling, however, seems not to be adequate to induce chick neural crest cells. Chick and other amniote vertebrates may well use different signaling mechanisms for initiating and maintaining neural crest cells than do nonamniotes such as the frog and zebrafish.

## Nature, Nurture, and Behavior

Childhood maltreatment is a well-established risk factor for antisocial behavior. However, only a subset of maltreated children exhibit such behavior later in life. Caspi *et al.* (p. 851; see the news story by Stokstad) investigated this interindividual variability by conducting a large longitudinal study of boys in New Zealand, looking at the interaction of genotype, childhood experience, and outcome in young adulthood. They focused on the gene encoding monoamine oxidase A (MAO A), which metabolizes several neurotransmitters and whose activity levels have been linked previously with aggression. Maltreated children with a genetic polymorphism conferring low MAO A activity were more likely to develop behavioral problems later in life. These findings, if they can be replicated in additional populations, attest to the importance of gene-environment interactions that can influence behavior.

## Viral Tricks

Herpesviruses replicate in the nucleus of host cells, but the particles formed are too big to pass through nuclear pores. How do they escape? Muranyi *et al.* (p. 854; see the Perspective by Sanchez and Spector) found that murine cytomegalovirus subverts the normal activity of a cellular protein to aid its escape. A pair of viral proteins (M50/p35 and M53/p38) form a "docking station" for the viral capsids on the inner nuclear membrane. M50/p35 then recruits cellular protein kinase C to phosphorylate and disassemble the filamentous protein network of the nuclear lamina.

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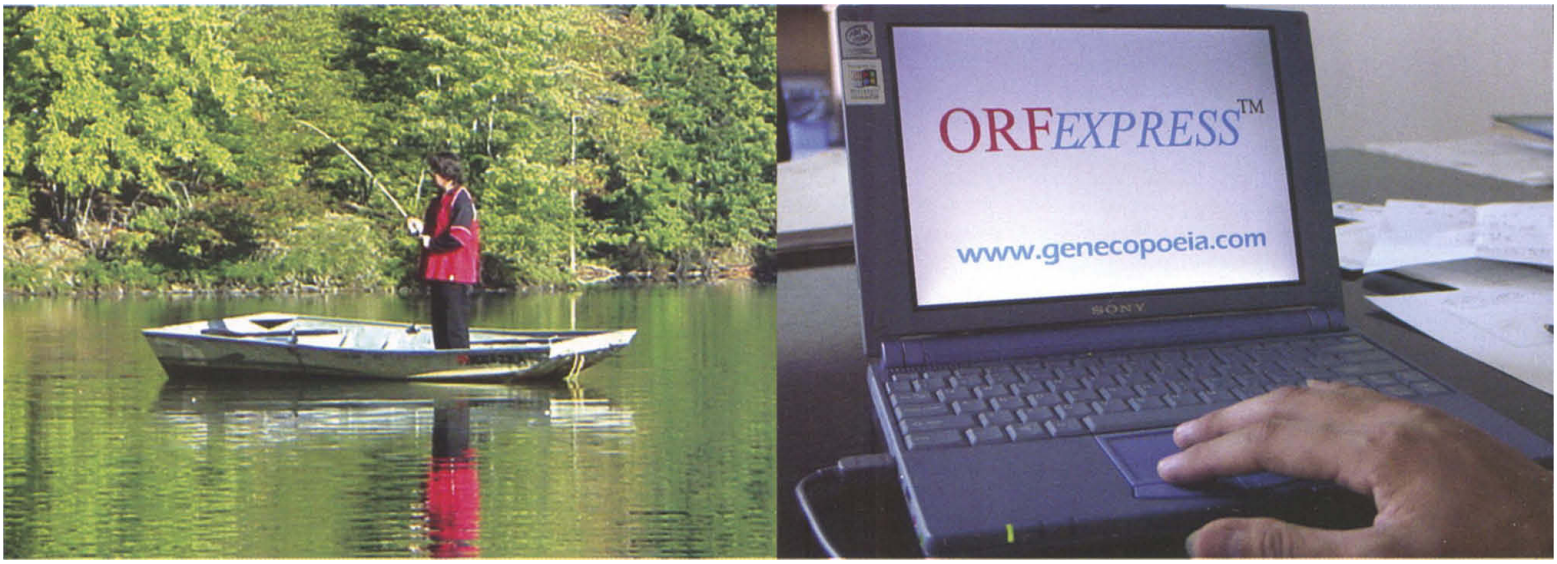


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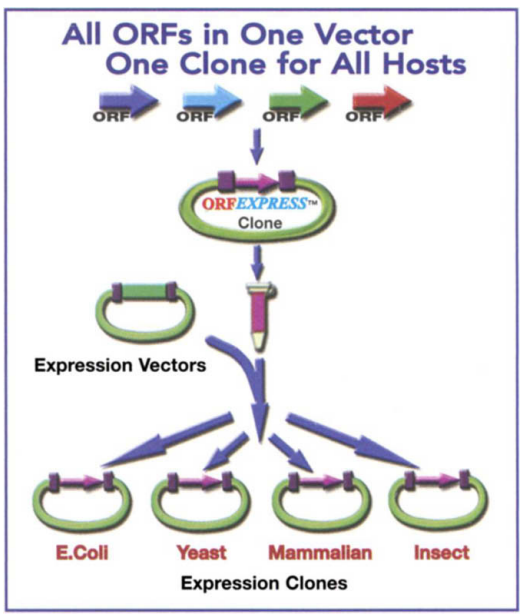


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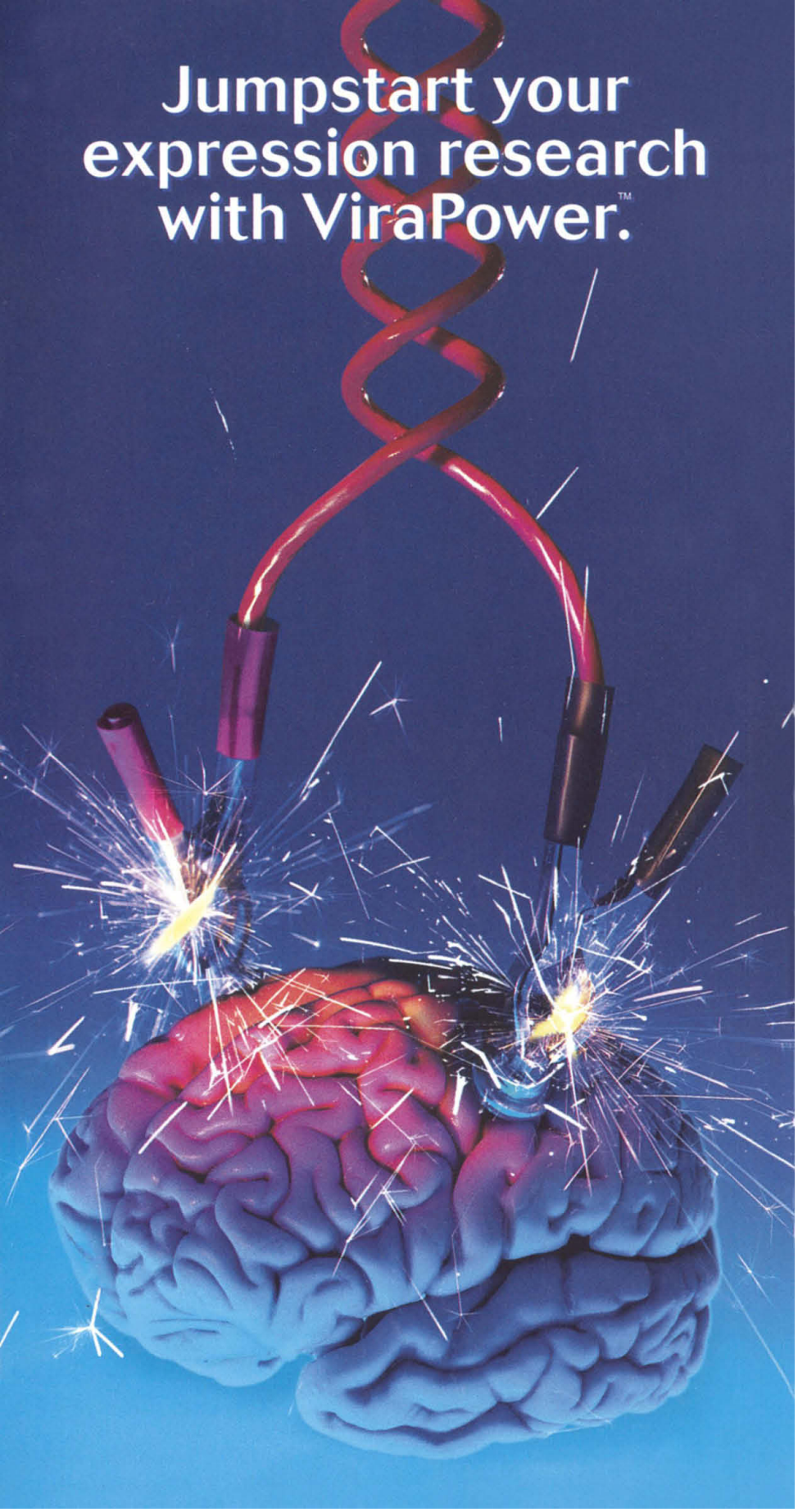


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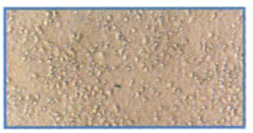

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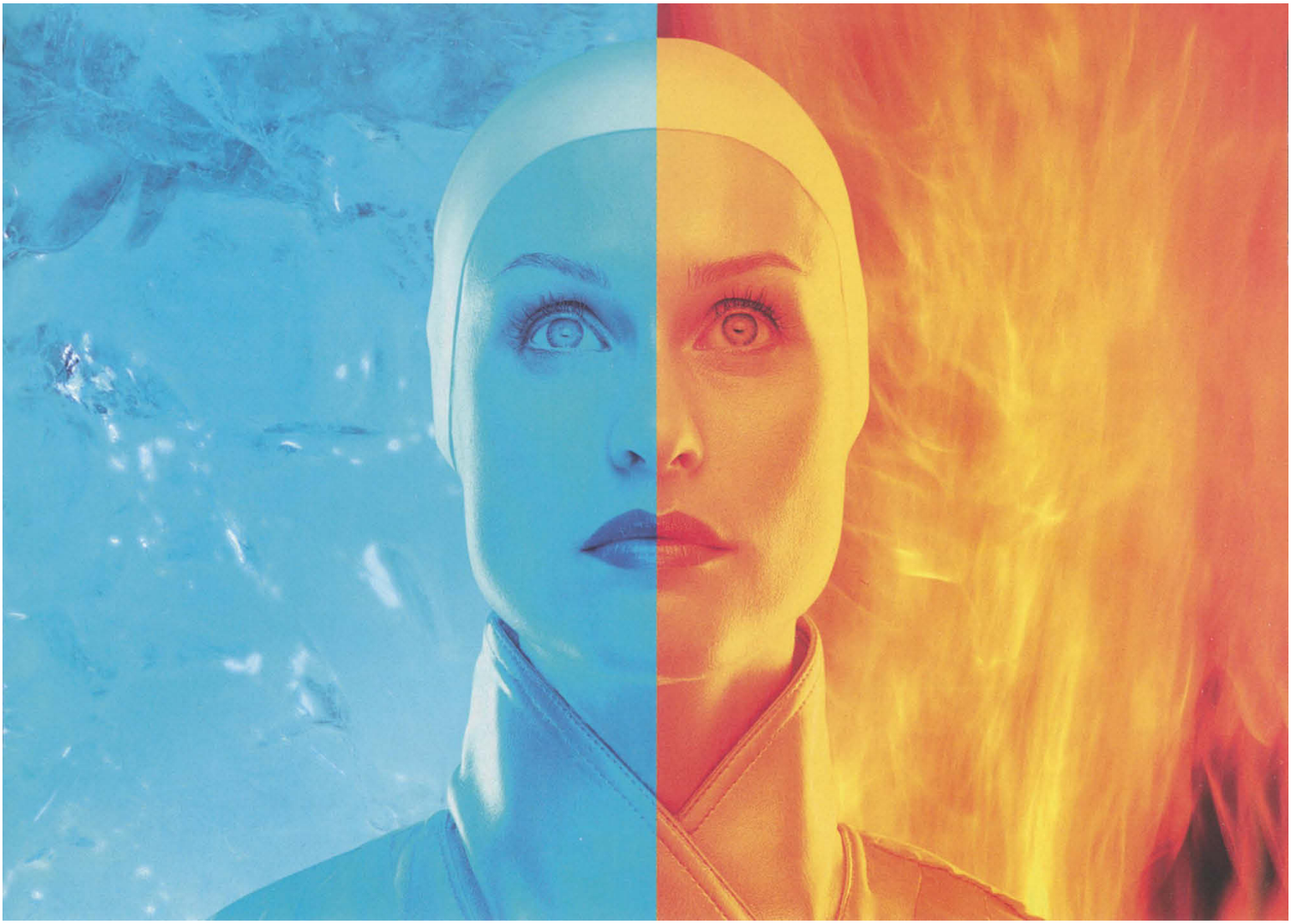

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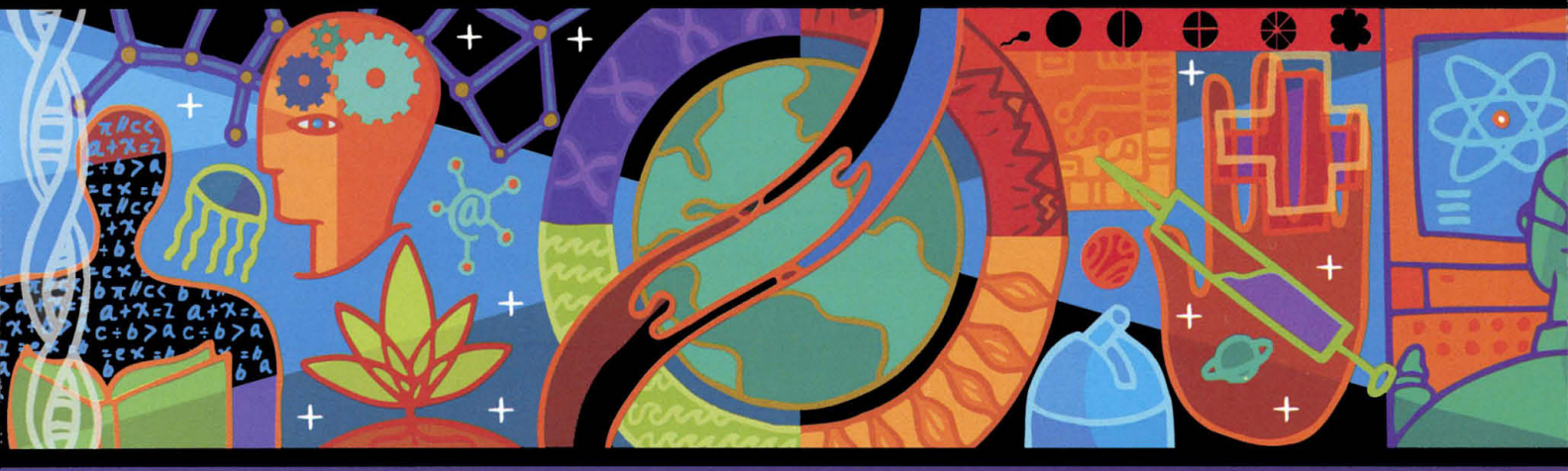

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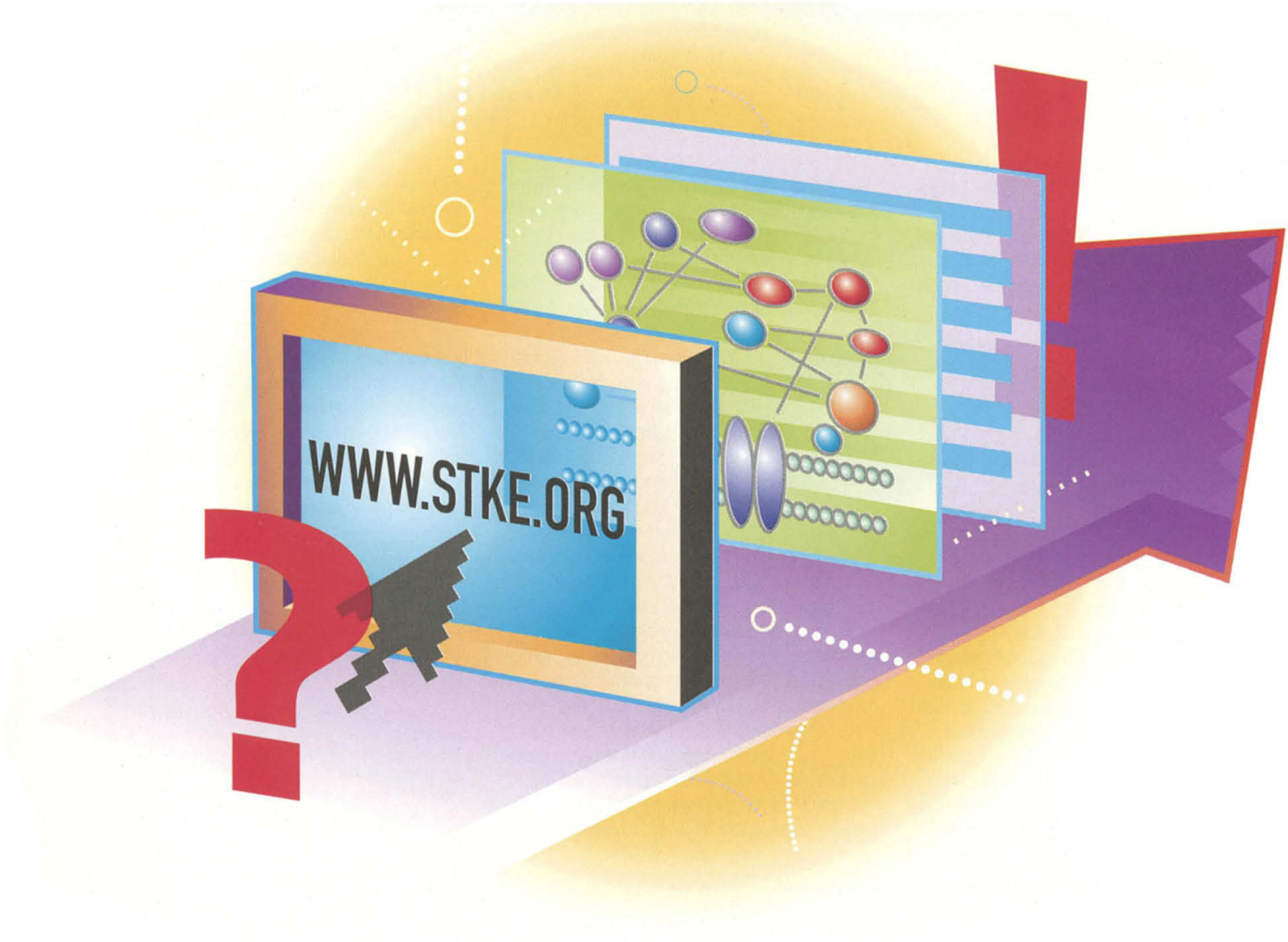


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