

2010 TECH PREVIEW

10 Concepts You Need to Know

Popular Mechanics

Science Technology Automotive Outdoors Home

CAR TEST
**CHEAP
SPEED**
GTI, WRX & More

HOW THEY TRACK YOU

**VEGAS CASINOS
KNOW ALL
YOUR SECRETS.**

**WHERE
ELSE
IS YOUR
PRIVACY
AT RISK?**

DIGITAL HOLLYWOOD

**The Amazing
3D Tech of *Avatar***

**We Ski With
Avalanche
Blasters**

DIY

Easy Modular Furniture
Touchscreen Netbook
Diesel Basics

PLUS:

Better Caulking
Car Electronics
New Uses for Silica Gel

DATA ON FILE

Name
Address
D.O.B.
License Plate
Soc. Sec.
Friends/
Associates
Gambling History
Day's Winnings
Favorite Drink

CAMEL SNUS
©2010 R.J. REYNOLDS TOBACCO CO.



BUCK ORDINARY

WARNING:

THIS PRODUCT
MAY CAUSE
MOUTH CANCER

58 View From the Brink

Director James Cameron dreams up movies that can't be made with existing technology, then invents the machinery to transform his fantasies into film. He puts his wizardry—and reputation—on the line with his latest project, *Avatar*, a 3D sci-fi epic.

BY ANNE THOMPSON

68 The Deadly Season

It's risky but potentially lifesaving work: Ski into the heart of avalanche country and bomb slide-prone slopes. PM glides along with the dawn patrol. Fire in the hole!

BY MICHAEL FINKEL

72 The Machines Are Watching

Las Vegas ... Sin City? More like Spy City. And the high-tech surveillance and data mining that keep casinos profitable and gamblers in line may soon be coming to a shopping mall, airport or workplace near you. Are you okay with that?

BY MICHAEL KAPLAN

→ → 80 Thrill Rides

Sure, we like our cars fast, but we also like them economical. To locate the sweet spot between high speed and low price, PM's tire-smoking auto team revs up six new road hustlers to find out who owns the fast lane.

BY LARRY WEBSTER

From left: PM auto editors Ben Stewart and Larry Webster confer with contributing tester Daniel Winter at Ohio's Nelson Ledges Road Course.

ON THE
COVER

Photographed for PM in October 2009 by Art Streiber at the Morongo Casino Resort & Spa, Cabazon, Calif., where customers willingly consent to legal high-tech surveillance and data gathering. But will these systems migrate elsewhere and be used for more insidious purposes?

diy

pm do-it-yourself

HOME

89 The New Cubism
If you can build a box, you can furnish a room. Here, steps to construct a versatile table, stackable shelves—even a bed.

92 Homeowners Clinic
Tips and tricks for flawless caulking. **Plus:** How to quiet a buzzing dimmer switch.

AUTO

97 Saturday Mechanic
Diesels are famously durable, but they still need attention. Follow these tips to extend your engine's life expectancy.

100 Car Clinic
Choosing correct turn-signal flashers. **Plus:** Should you replace both rear-brake wheel cylinders at the same time?

TECH

106 The DIY Touchscreen PC
We turn a standard netbook into a finger-friendly machine.

108 Digital Clinic
Surprising ways silica gel saves electronics. **Plus:** What drains a smartphone's battery faster—3G or Wi-Fi?

LISTED ON THE COVER

50 2010 Tech Preview
80 Cheap Speed
72 How They Track You
58 Digital Hollywood
68 We Ski With Avalanche Blasters

TECH WATCH

13 Nuclear Recharge
Long-lasting, nuke-powered batteries charge hard-to-access gear. **Plus:** What the Air Force fears most.

UPGRADE

23 Cool Breeze
The Dyson Air Multiplier is the world's first bladeless fan. **Plus:** Garbage bags get the Abusive Lab Test treatment.

NEW CARS

35 Leading Man
GM may hit its stride with the new Terrain. **Plus:** Genius at the Frankfurt Motor Show.

COLUMNS

44 Jay Leno's Garage
In the 1950s, the Fiat was an Italian staple—and Jay thinks it has the potential to be a go-to car in the U.S. too.

48 The Future of Fat
Fat isn't just blubber—it's a complex organ that could help you lose weight.

50 10 Tech Concepts
From anthropomimetic machines to piezoelectric displays, PM takes you through the big ideas that will make headlines in 2010.

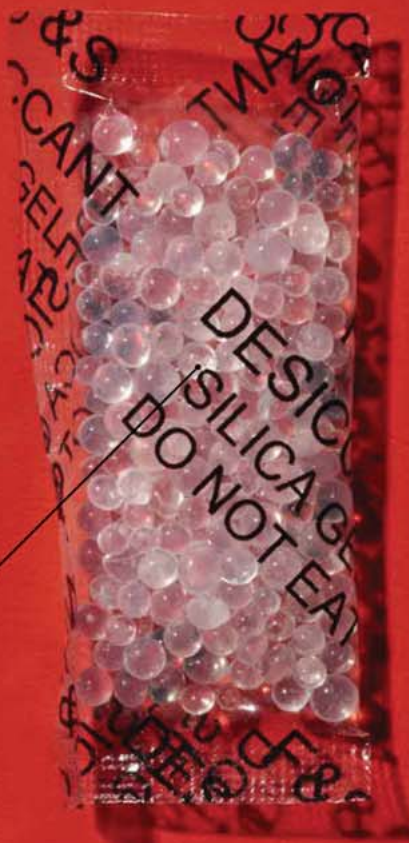
56 How It Works: Ocean Rower
A look inside the boat that a 22-year-old athlete will row solo across the Atlantic Ocean.

108

DIGITAL CLINIC
The Many Uses of Silica Gel

14

42



THE POWER
AND VERSATILITY
OF SIX TOOLS.
PACKED INTO ONE.

INTRODUCING THE 12-VOLT CRAFTSMAN CORDLESS MULTI-TOOL

With the ability to sand, scrape, saw, and smooth, this portable tool puts the power to complete any job right in the palm of your hand. With innovation and better value, trust that Craftsman has the tool to get the job done right. Find it at craftsman.com

Sears THE HEADQUARTERS OF CRAFTSMAN

CRAFTSMAN®

TRUST. IN YOUR HANDS.

PopularMechanics

JAMES B. MEIGS
Editor-In-Chief

Executive Editor David Dunbar
Design Director Michael Lawton

EDITORIAL

Editor, Automotive Ben Stewart
Senior Editor, Automotive Mike Allen
Senior Editor, Home Roy Berendsohn
Senior Editor, Science Jennifer Bogo
Senior Editor, Technology Glenn Derene
Detroit Editor Larry Webster
Associate Editors Joe Pappalardo,
Seth Porges, Harry Sawyers
Research Director David Cohen
Assistant Editor Erin McCarthy
Assistant to the Editor-In-Chief Allie Haake

Contributing Editors:

Jim Gorman, Chris Grundy, Ben Hewitt,
Carl Hoffman, Alex Hutchinson, Joel Johnson,
Tom Jones, S.E. Kramer, Jay Leno,
Fred Mackerodt, The MythBusters
(Jamie Hyneman, Adam Savage), Joe Oldham,
Glenn Harlan Reynolds, Noah Shachtman,
Erik Sofge, Kalee Thompson, Joseph Truini,
James Vlahos, Logan Ward, Jeff Wise

SUBSCRIPTIONS

subscribe.popularmechanics.com

Deputy Editor Jerry Beilinson
Managing Editor Michael S. Cain

ART

Senior Art Director Peter Herbert
Associate Art Director Stravinski Pierre

PHOTOGRAPHY

Director of Photography Allyson Torrisi
Associate Photo Editor Michele Ervin

PRODUCTION

Assistant Managing Editor Emily Masamitsu
Copy Editor Robin Tribble

IMAGING

Digital Imaging Specialist Anthony Verducci

POPULARMECHANICS.COM

Online Director Angela Diegel
Online Editor Tyghe Trimble

PROJECT ASSISTANT

Alyson Sheppard

INTERN

Shelby Neblett

Contributing Photographers & Illustrators:

Burcu Avars, Tim Bower, Gordon Chapman/
Studio Catastrophic FX, Brad DeCecco, Dogo,
Chad Hunt, Scott Jones, Ed Keating, Axel de Roy,
Dan Saelinger, Gabriel Silveira, Sinelab,
Art Streiber, Transluzent, Dan Winters

EDITORIAL BOARD OF ADVISERS

POPULAR MECHANICS is grateful to these scientists, innovators and leaders, who help ensure we cover the most important stories in the most authoritative way.

BUZZ ALDRIN

Apollo 11 astronaut; colonel, U.S. Air Force (Ret.)

SHAWN CARLSON

Executive director of the Society for Amateur Scientists; MacArthur Fellow

DAVID E. COLE

Chairman, Center for Automotive Research

SAUL GRIFFITH

Chief scientist, Other Lab; MacArthur Fellow

DR. KEN KAMLER

Surgeon; author of *Surviving the Extremes*

GAVIN A. SCHMIDT

Climate modeler, NASA Goddard Institute for Space Studies

AMY B. SMITH

MIT instructor; leader in appropriate technology movement

DANIEL H. WILSON

Robotics; author of *The Mad Scientist Hall of Fame*

WM. A. WULF

President, National Academy of Engineering

WHAT THEY'RE DOING



★ THOMAS D. JONES

Space shuttle astronaut and author of *Sky Walking*, Tom Jones presented the case for manned voyages to near-Earth asteroids to the Augustine Commission last summer as it worked to make conclusions about the future of human spaceflight. An advocate for increased funding of deep-space exploration, the astronaut is also writing a children's book to educate kids and excite them about space exploration and careers in aerospace technology.



BILL CONGDON
Publisher

Associate Publisher Jane Wladar | *General Manager* Bruce A. Mitnick
Executive Marketing Director Mike Kresch

Online Advertising Director Matthias Wolf
Marketing Director Barbara Serino
Associate Marketing Manager Johanna Hessling
Group Production Director Karen Otto
Group Production Manager Carole Hartman
Associate Production Manager Karen Nazario

Creative Director Glen Fuenmayor
Marketing Manager Chad Meany
Online Marketing Coordinator Janette Hong
Vice President, Group Consumer Marketing
Director Rick Day
Advertising Coordinator Carolyn Yanoff

ADVERTISING SALES OFFICES

NEW YORK

East Coast Sales Manager Ray Rienecker 212/649-2876
Account Manager Matthew Schwagerl 212/649-2902
Account Manager Cameron Alberg 212/649-2901
Sales Assistant Vanda Danbunpoth 212/649-2853

CHICAGO

Manager Spencer J. Huffman 312/984-5191
Account Manager Matt Avery 312/251-5355
Sales Assistant Yvonne Villareal 312/984-5196

SPECIAL SECTION SALES

Samantha Yarock 212/649-2850
Beth Boyle 914/461-3269

DIRECT RESPONSE ADVERTISING

Angela Hronopoulos 212/649-2930

LOS ANGELES

Account Manager Brittany Marquis 310/664-2921
Sales Assistant Cari Nelson 310/664-2922

DETROIT

Manager Robert Reynolds 248/614-6120
Sales Assistant Toni Starrs 248/614-6011
Hearst Magazines Sales, Inc.

DALLAS

Account Manager Patty Rudolph 214/824-9008
Weikel Media

SAN FRANCISCO

Northwest Manager Andrea Weiner 415/859-5565
Athena Media Partners

CLASSIFIED ADVERTISING REPRESENTATIVE

Kathleen Gleason 888/473-0788; fax: 708/352-4094
Klassmark, 52 W. Burlington Ave., La Grange, IL 60525

PUBLISHED BY THE HEARST CORPORATION

Frank A. Bennack, Jr.
Vice Chairman & Chief Executive Officer

George R. Hearst, Jr.
Chairman

HEARST MAGAZINES DIVISION

Cathleen Black
President

Michael Clinton
*Executive Vice President,
Chief Marketing Officer
& Group Publishing Director*

John P. Loughlin
*Executive Vice President
& General Manager*

Gilbert C. Maurer
Publishing Consultant

Mark F. Miller
Publishing Consultant

how to reach us

E-Mail popularmechanics@hearst.com. **Mail** Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. **Fax** 646-280-1081. Please include your name, address and a daytime phone number. Letters may be edited. **Subscription Questions** For customer service, change of address and subscription orders, log on to service.popularmechanics.com, or write to Customer Service Department, Popular Mechanics, P.O. Box 7186, Red Oak, IA 51591. **Back Issues** Write to Hearst Single Copy Sales, P.O. Box 7763, Red Oak, IA 51591-0763. **Reprints** Call 800-659-9878.

9 MILLION CUSTOMERS HAVE VOTED.

THANKS

FOR MAKING US THE WORLD'S #1 WEB HOST!

Your loyalty has helped make us the leading web hosting provider worldwide. 1&1 was built on a foundation of innovative products and outstanding reliability, and we continue to strive to bring you high-quality products at affordable prices. To show our appreciation, we're offering discounts on our most popular products.

DOMAINS

	1&1	Yahoo!	Go Daddy
.com	\$8.99	\$9.95	\$10.69
Private Domain Registration	FREE	\$9.00	\$8.99
ICANN Fee	Included	Included	\$0.18
E-mail Account	FREE 2 GB Mailbox	NO Mailbox Included	FREE 1 GB Mailbox
Total Annual Cost	\$8.99 \$6.99 first year*	\$18.95	\$19.86

BUSINESS WEBSITES

Powerful website solutions for your small business.

- 1&1® Business Package
- 3 FREE Domain Names
- 250 GB Web Space
- **UNLIMITED** Traffic

~~\$9.99~~
per month

3 months FREE!*



HURRY, SPECIAL OFFERS END 12/31/2009!

More special offers are available online, visit www.1and1.com

*Offers valid through December 31, 2009. "3 Months Free" offer valid with a 12 month minimum contract term only. Setup fee and other terms and conditions may apply. Visit www.1and1.com for full promotional offer details. Program and pricing specifications and availability subject to change without notice. 1&1 and the 1&1 logo are trademarks of 1&1 Internet AG, all other trademarks are the property of their respective owners. © 2009 1&1 Internet, Inc. All rights reserved.



Call **1-877-GO-1AND1**
Visit us now **www.1and1.com**

1&1



PM LETTERS

Engineering the Future

I agree 100 percent with Dean Kamen, recipient of a 2009 Popular Mechanics Breakthrough Award (Nov. '09), when it comes to the United States' need for more hands-on learning.

Throughout high school I looked forward to college, thinking I would finally have the chance to practice the theory I was learning. But after I got there, I did not have the opportunities I had expected—it was just more lab reports and textbook homework. I couldn't even use the machine shops to make parts for a robot I was building on my own time. With just one semester left before I complete my B.S. in engineering, the only things I have built are a model of a lathe and a small aluminum truss.

There has to be hands-on learning in schools and universities, or students will lose interest in science and technology. Right now I am trying to decide if I want to go to graduate school next fall. But if it's just going to be more of the same, why bother?

DAVID HOFF
ELKHART, IN



ISSUE

11 / 09

x

Readers responded to the work of Breakthrough Award recipient Dean Kamen, to a mileage test and to Ethernet wiring.

I have witnessed first-hand the spark that Mr. Kamen's FIRST Lego League can create in a child—it's unlike anything else. The child discovers that he has the power to create what doesn't exist, to influence the world in a positive way. It's really amazing. Dean: You are greater than the sum of your own actions. You've inspired the actions of others and there is simply no greater accomplishment.

PAUL BERNARD
MONT VERNON, NH

High-Mileage Passion

Thanks for the roundup of today's high-mileage cars, including the Ford Fusion and Audi A3 TDI, in "Mileage Masters." While the Smart Fortwo Passion didn't rate very highly in some areas, I think it did pretty well, considering it costs less than half as much as all of the other cars (except the Honda Insight). But then again, I am a Smart owner and really

like the little rascal—its deficiencies add to its charm.

JACK DIEHL
VERO BEACH, FL

I must object to your review of the Smart car in a recent test. I've been driving a Smart Passion for about six months and find the ride smooth—nothing like your expert claims. I also find it's powerful enough for any hill, roomy and just plain fun to drive. Plus, it's averaging 42 mpg on the highway and 38 in the city. I've taken it on some pretty gnarly back roads, and it's performed above expectations.

KEITH ARNOLD
LAKE STEVENS, WA

Hard-Wired Home

I was glad to see your story on installing Ethernet cable to increase a home network's bandwidth. Having just wired my house, I have to point out something I learned: I found that the order of the wires does make a difference. Though logic told me your way made sense—be consistent from end to end—my computers would recognize a connection but could not transmit a signal. Hope readers find this helpful.

DJ ROFF
NEW CASTLE, DE

→ **EDITOR'S NOTE:** The wires inside an Ethernet cable are all physically the same, so it should transmit a signal as long as the color coding is identical at both ends, which is our experience. But, it makes sense to arrange them according to the U.S. standard, since installation takes the same amount of time. Plus, it'll make splicing or repair easier.

what
do you
think?

Write to Us Include your full name, address and phone number, even if you correspond by e-mail. Send e-mail to popularmechanics@hearst.com. All letters are subject to editing for length, style and format.

Subscribe Please go to subscribe.popularmechanics.com.



Our heart is in racing, but our hands are everywhere.

Where's your next project? Whether it's at the race track, at home, in a workshop, at a jobsite or in your own garage, Mechanix Wear has a glove specifically designed to protect your hands and help you work faster, safer and cleaner. So next time you're looking for the perfect tool for the job, start with Mechanix Wear gloves. The Tool That Fits Like a Glove.® 800.222.4296 Canada: 604.542.7055

TM 2010 Stewart-Hess Racing



ORIGINAL™
BLACK



Breakthrough Night

AT PM'S FIFTH ANNUAL BREAKTHROUGH AWARDS GATHERING, SPACE SCIENTISTS, TEST PILOTS, ROBOTICISTS AND MORE SHARED IDEAS ON THE FUTURE OF TECHNOLOGY.

OCT. 8, 2009
HEARST TOWER, NYC

→ **The 2009 Popular Mechanics Breakthrough Awards event took place Oct. 8 at PM's high-tech home, the LEED-certified Hearst Tower in New York City.**



1

1. Guests and award winners looked on as two robots, built by FIRST Robotics teams from Saunders and George Westinghouse high schools, battled in the ring.

2. Breakthrough Leadership Award winner Dean Kamen issued a call to arms for technical innovation in the United States.

3. Shawn Frayne (left), a 2007 winner, discussed alternative energy in developing countries with (from left) PM's Glenn Derene and Logan Ward, and 2009 winner Hugo Van Vuuren.

4. Editor-in-chief Jim Meigs (right) presented a Breakthrough Award to Xbox innovator Alex Kipman for the Natal—which attendees used in PM's Breakthrough gallery space.

5. The Maverick flying car, destined for use in the Amazon, drew stares on Eighth Avenue.

6. Greg Schroll (right), 2009 Next Generation Breakthrough winner, discussed intricacies of gyroscope-based spherical robots.



Dean Kamen
Leadership Award



3



4



5



6

PHOTOGRAPHS BY GLEN FUENMAYOR (TOP); SARAH SHATZ (ALL OTHERS); ILLUSTRATION BY AXEL PFANDER

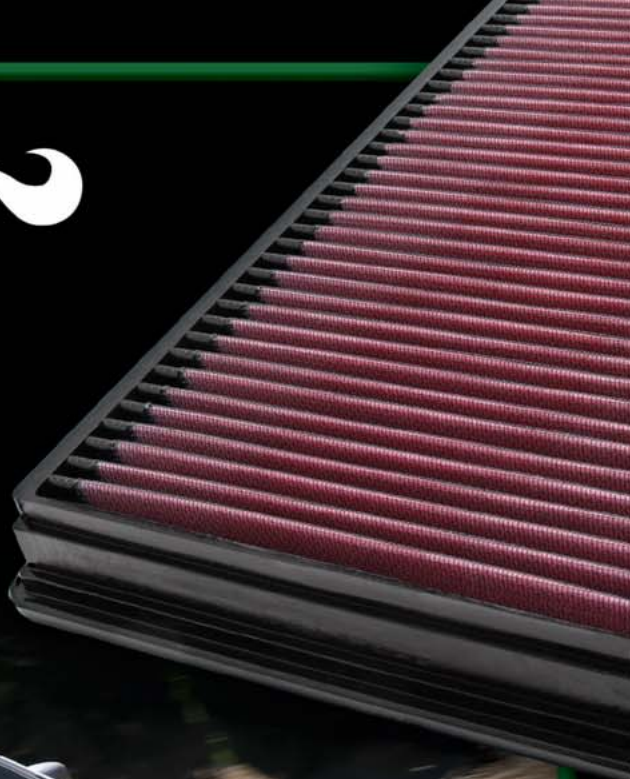




LIFETIME AIR FILTERS

Made From Cotton Instead of Paper, a K&N Replacement Air Filter Never Needs to be Replaced. K&N Washable Air Filters Can Help Reduce Waste, Help Save Energy and Trees.

K&N MAKES SENSE...NOW MORE THAN EVER



K&N OE Replacement Air Filters are backed by the World's First Million Mile Limited Warranty

Up To
50,000 Miles
Between Cleanings

Under Normal Highway Driving Conditions

K&N LIFETIME AIR FILTERS FOR MOST VEHICLES

Chevy Camaro	2010	3.6/6.2L	33-2434	Jeep Grand Cherokee	2005-09	4.7L	33-2233
Chevy Malibu Hybrid	2009-10	2.4L	33-2288	Jeep Wrangler	2007-09	3.8L	33-2884
Chevy Silverado 1500	1999-09	4.8/5.3L	33-2128	Kia Soul	2009-10	1.6/2.0L	33-2880
Dodge Ram 1500	2003-09	5.7L	33-2247	Nissan Altima Hybrid	2008-09	2.5L	33-2874
Ford F-150	2009	4.6/5.4L	33-2885	Nissan Titan	2004-09	5.6L	33-2288
Ford Mustang GT	2010	4.6L	33-2431	Tacoma	2005-10	4.0L	33-2281
Honda Civic	2006-09	1.8L	33-2842	Toyota Camry Hybrid	2007-09	2.4L	33-2280
Honda Insight	2009-10	1.3L	33-2433	Toyota Prius	2010	1.8L	33-2435
Hyundai Genesis Coupe	2009-10	2.0/3.8L	33-2858	Tundra	2007-10	5.7L	33-2887

Thousands more applications available at knfilters.com®

Join The Millions of People Who Have Discovered K&N
**The Cleanable Air Filter That Can Help
Your Car Run Better And Save Energy**

1-800-871-0560

©2010 K&N Engineering, Inc.

knfilters.com/pm



× JANUARY

A Better Planet



ALTERNATIVE ENERGY PM evaluates technology large and small for cheaply, safely and cleanly meeting energy needs in the United States and around the world. Our coverage runs the gamut from micro-hydroelectric power to next-generation nuclear plants, from fusion research to wind turbines, and from better solar photovoltaics to plain old efficiency.
popularmechanics.com/science

THE FIGHT FOR WATER Debates about water usage go hand-in-hand with any discussion of energy efficiency, carbon emissions and climate change. Fights over water rights are heating up in both drought-prone and rainy regions. Meanwhile, homeowners are opting for DIY methods to conserve water, and communities are clamoring for the technology to make water cleaner. Where water woes arise, PM has the scoop.
popularmechanics.com/science

THE FUTURE OF FUEL Will our cars and trucks run on hydrogen, electricity, gasoline, ethanol, biodiesel or something else entirely? POPULAR MECHANICS isn't waiting to find out. That's why we cover all emerging automotive technology—from plug-in infrastructure being built now to fuel cell research for a better tomorrow.
popularmechanics.com/automotive

PHOTOGRAPH BY GETTY IMAGES

Love
Your Car?
You'll Love
"My Wheels"



Join myWheels, the new user-powered auto community on popularmechanics.com

Submit your car for the "Castrol EDGE Car of the Month", share photos, swap tips and more.

Visit www.popularmechanics.com/myWheels for more information.



Wrangler

YOU CAN COUNT
ON WRANGLER.

For unbeatable comfort, quality and value, pick up a pair of Wrangler Five Star Premium Denim Jeans. Wrangler: Real. Comfortable. Jeans.

www.wrangler.com



Build Your Own Legend

More people build Factory Fives than any other kit. Period. We've lead the industry in quality, engineering, and value since 1995. For a free brochure and DVD, call 508-291-3443 or visit www.factoryfive.com.





It's the captain of MP3s. Your words are the DJ.



MUSIC SEARCH

JUST ONE OF THE MANY AMAZING FEATURES FROM SYNC[®],
THE VOICE-ACTIVATED IN-CAR TECHNOLOGY AVAILABLE
EXCLUSIVELY ON FORD, LINCOLN AND MERCURY VEHICLES.*

SYNC. Say the word.



hands-free calling • **music search** • vehicle health report • turn-by-turn navigation • business search • 911 Assist[™] • real-time traffic • audible text • my favorites
Learn more about all SYNC features at syncmyride.com

*Driving while distracted can result in loss of vehicle control. Only use mobile phones and other devices, even with voice commands, when it is safe to do so.

MTM SPECIAL OPS



BLACK SEAL

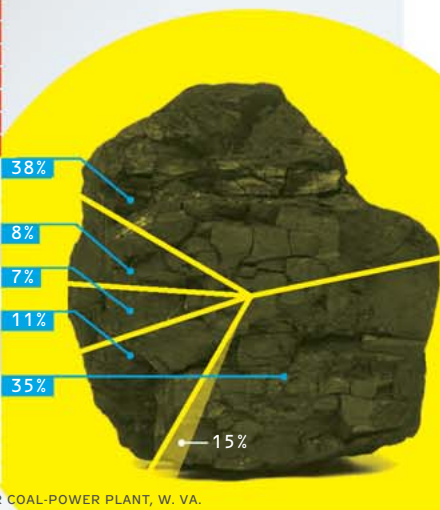
Also available in
brushed silver finish

W W W . S P E C I A L O P S W A T C H . C O M

The MTM Special Ops line of tactical time pieces is exclusively available through **MTM**.
Toll free at 1800 284 9487 outside of USA 1 213 741 0808 1225 South Grand Ave. Los Angeles, CA. 90015.

THE BULK OF A COAL POWER PLANT'S POTENTIAL ENERGY IS LOST TO ON-SITE PROCESSES, INCLUDING CARBON-CAPTURE TECH:

To heat that escapes, unused, when coal burns. 38%
To operate pumps and fans. 8%
To drive water out of coal. 7%
To grind coal and remove unwanted fly ash residue. 11%
To the grid as power. CCS at the plant uses 15 percent of this electricity. 35%



SOURCE: MOUNTAINEER COAL-POWER PLANT, W. VA.

NEWS + TRENDS + BREAKTHROUGHS



TechWatch

POWER SINK Efforts to curb the output of global warming gases are taking a toll on the already unimpressive efficiency of coal-power plants. For example, experimental carbon-capture and sequestration (CCS) technology reduces carbon-dioxide emissions by injecting the byproduct gas into ground wells—and also cuts into the power provided to the grid. — HARRY SAWYERS

A Million Times More Powerful Than An Ordinary Battery

+ Engineers at the University of Missouri recently unveiled a nuclear-powered battery that is about the size of a penny—and they hope to produce one thinner than a human hair. The researchers do not design pocket reactors: The batteries harvest electricity from the emissions of decaying radioactive isotopes. Long-lasting nuclear batteries are currently used in spacecraft, but the relatively large size of their semiconductors limits their use. Solid semiconductors withstand the exposure because they have no such structure. The batteries could be used in miniature internal medical devices, remote sensors and other hard-to-recharge applications. — ALEX HUTCHINSON

WIRELESS EYES

+ A team of MIT researchers has entered the race to develop an implant that can restore partial vision to the blind. Unlike other implants under development, MIT's system does not place electrodes directly on the retina, which can damage the eye during implantation. Instead, the device stimulates nerves near the eyeball that carry visual information to the brain. A pair of eyeglasses, equipped with a camera, beams



visual information and power to the chip. A coil around the iris relays the images to a chip attached to the side of the eyeball (above), which sends the data to electrodes implanted below the retina. The researchers won't know what patients would "see" until they begin human trials in 2013.

LISTENING TO LEAVES

+ Western Washington University geophysicists are making localized air-pollution maps by tracking the magnetism of tree leaves. Car and some industrial pollution contains particles of magnetic iron oxide that stick to the leaves, making them magnetic.



DANDELION - ENZYME = TIRE

← Scorned as a weed, the dandelion is a potential source of natural rubber, according to scientists at the Fraunhofer Institute in Munich, Germany. The white liquid that seeps from a broken dandelion stalk is natural latex, but the sap is ill-suited for industrial use because it immediately begins to harden. The researchers identified an enzyme in the plant that causes this rapid polymerization and found that the sap can produce five times more latex if the enzyme is chemically "turned off." Dandelions might make an attractive backup as a rampaging fungus attacks rubber trees in Southeast Asia, where the vast majority of the world's natural rubber is now grown.

What Scares the Air Force

A PENTAGON OFFICIAL WARNS THAT U.S. WARPLANES MIGHT NOT ALWAYS RULE THE SKY.

BY JOE PAPPALARDO

→ **The United States Air Force** is the best trained and most expensively equipped in the world. So what is there to worry about? Plenty, says Lt. Gen. David Deptula, the USAF's deputy chief of staff for intelligence, surveillance and reconnaissance. U.S. warplanes are not threatened by insurgents, but other potential foes are developing hardware that could change the equation. Discussing such threats in public, as Deptula did during a recent briefing outside Washington, D.C., is a familiar tactic to drum up government support, but public briefings are also opportunities for key Air Force officials to honestly state their top priorities to defense contractors, academics and uniformed service members.



→ A pair of binoculars and a cellular phone can threaten modern warplanes. In 1999 Serbian airplane spotters watched U.S. aircraft leave an airbase in Italy. The spies alerted anti-air-missile battery crews in Serbia to aim their long-wavelength radar overhead,

enabling the crews to destroy a stealth F-117A Nighthawk. Airfields are also at risk from a growing number of short- and medium-range missiles, which can be tipped with explosive, chemical or biological warheads.



→ Conventional radar ranges are increasing, and that's just the start of the problem. Over-the-horizon radar can detect airplanes by bouncing signals off the ionosphere, 56 miles above Earth, while passive radar can provide enemies

with rough tracks of an airplane's location, direction and altitude. If enemies know that the airplanes are coming and where they are heading, they can fire up their radar, hide military assets, warn targets and scramble warplanes.



→ There is an international boom industry in anti-aircraft missiles and warplanes that are designed to defeat U.S. stealth technology. Surface-to-air missiles are good and getting better—Russia's S-300 tracks up to a hundred targets from more than 125

miles away. Large numbers of new Russian and Chinese fighters—with great radar and stealthy features, and sold on the open market—could overwhelm superior American planes like the F-22 Raptor and the yet-to-enter-service F-35 Lightning II.

TAKE IT OR LEAVE IT.

FREEDOM TO TAKE YOUR TOOLS WITH YOU,
AND THE SECURITY TO LEAVE THEM BEHIND.

STANLEY
GUARD
SECURITY ALARM SYSTEM



KEYPAD ALARM ALLOWS ACCESS
WITH PERSONALIZED CODE



LOCKS INTO EASY-TO-MOUNT DOCKING
STATION & FITS ANY TRUCK BED



WATER SEAL KEEPS THE ELEMENTS OUT
& VERTICAL STORAGE ORGANIZES TOOLS



8.5" WHEELS PROVIDE MAXIMUM
PORTABILITY FOR TOUGH TERRAIN

The Best of Both Worlds for Truck Owners: Extreme Security & Versatility

The Stanley® Portable Truck Box can undock from your truck bed in seconds to make room for lumber or other materials. Day or night, an innovative keypad alarm system stands ready to alert you if someone is tampering with it. An integrated water seal also protects your tools from the elements.

Visit a Lowe's near you to see the innovation behind the The Stanley® Portable Truck Box.

Available only at:



STANLEY

stanleytools.com



Nanoscale Paparazzi

The microscope could examine never-before-seen interactions as they happen, like these white blood cells battling a larval parasite.

→ **Electron microscopes** can see things 1000 times smaller than what is visible with light microscopes, but they have a large limitation: They create doses of radiation that kill any microorganism being examined. Researchers at MIT have proposed an alternative that uses two stacked rings to divert the electron beam above or below the specimen, never striking it directly. Electrons would easily hop from ring to ring until an object placed between the loops traps electrons on one side or the other. The microscope would then register a dark spot. Combining the dark and light points would create a detailed black-and-white image. The new microscope could produce the first “live” images of biological phenomena, such as the chemical processes of white blood cells or even the individual nucleic acids in DNA. An early prototype could be operational within the next five years.

Too Much Information

DESIGNERS COME UP WITH NEW WAYS TO SOUP UP DISK DRIVES TO FACE THE COMING DATA CRUNCH.
BY TYGHE TRIMBLE

→ **Hard drives could reach their limits by 2015** unless researchers can find new ways to cram more information onto their disks. These drives use electrical pulses to create magnetic patterns on grains stored in rings on disks; when the disks spin, a scanner reads the patterns of electrical resistivity to retrieve the information. The storage capacity of the hard drive has risen from less than 0.1 gigabits (Gb) per square inch to over 100 Gb per square inch today. One breakthrough is “perpendicular recording,” which adds a bottom layer of magnetically weaker material to the disk, allowing it to store extra information. However, consumers’ need for more space to store videos, commercial information and experimental data is outpacing hard-drive development, so designers are seeking new ways to satisfy this growing appetite.

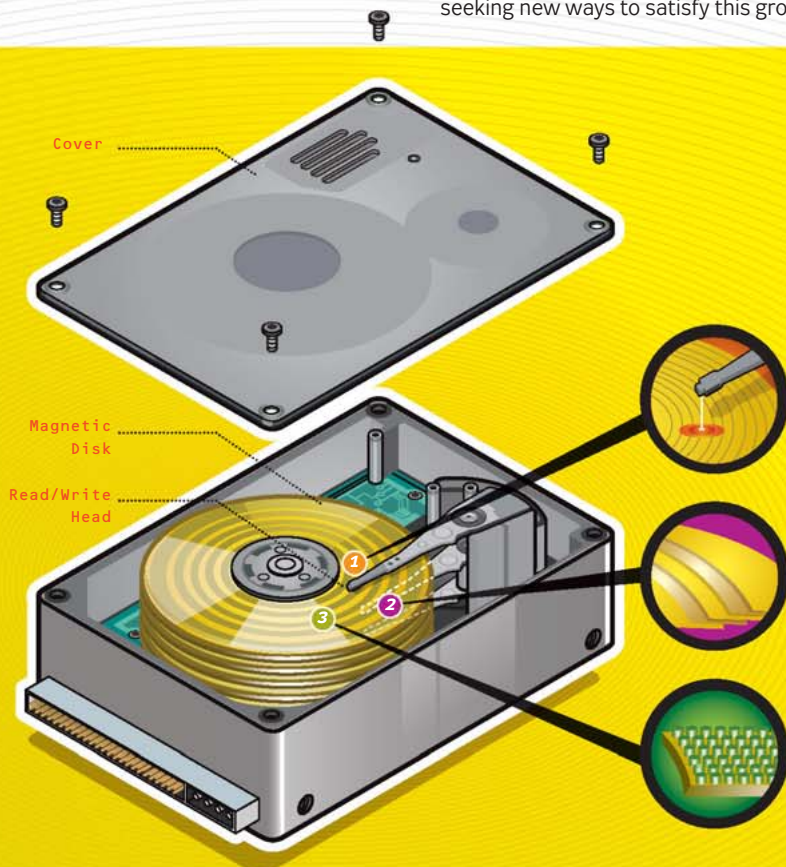
2 Two-Dimensional Rings

→ Disks currently store data in independent concentric tracks, wasting some space. Designers are looking for ways to overlap the rings and still read data. If the read/write head could identify patterns when adjacent tracks interact, and pluck the correct data from the interaction, the storage potential of a disk would be increased.

THREE WAYS TO DEEPEN DISK DRIVE STORAGE

1 Laser Enhanced
→ Heat-assisted magnetic recording uses a laser to heat a nanometer-size region on the disk at the moment when it is writing information. The heat enables the disk to cleanly store more information, and rapid cooling stabilizes the written data and reduces interference later.

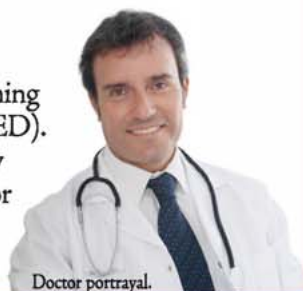
3 Bit-Patterning
→ Magnetic grains could be stored in some organized way, such as in a series of 10-nanometer-wide magnetic islands etched into a disk by an electron beam. This would allow a much greater volume of information to be stored.



“ I thought at my age there was nothing I could do about it, then I had ‘the talk’ with my doctor. ”

Your Doctor Talks to Men About ED Every Day

Your doctor will tell you that there is something you can do about your erectile dysfunction (ED). In fact, millions of men over 40 have already taken the first step and talked to their doctor about ED. And so can you.



Doctor portrayal.



Need Some Ideas on How to Open Up to Your Doctor?

The hardest part about having ‘the talk’ is getting those first few words out. Here are some ideas to help you break the ice when your doctor asks how everything’s going:

The Direct Approach:
“I have trouble sometimes in bed. Could it be ED?”

The Indirect Approach:
“Is it true age affects sexual performance?”

The Silent Approach:
Just hand this ad to your doctor, he’ll take it from there.

Running the Numbers

Did you know half of all guys over 40 have some form of ED? Here are some numbers to keep in mind from a recent survey of men with ED:



71% of men were anxious about talking to their doctor about ED.



89% of men felt relieved after talking to their doctor.



Tell Me More

To learn more about VIAGRA for the treatment of ED, and ED in general, visit viagra.com today. You’ll find an online sexual health quiz, videos of guys with ED who’ve had the VIAGRA Talk and other helpful information.

Over 20 million men have already had their VIAGRA Talk. Isn’t it time you had yours?

Important Safety Information

We know that no medicine is for everyone. Don’t take VIAGRA if you take nitrates, often prescribed for chest pain, as this may cause a sudden unsafe drop in blood pressure.

Talk with your doctor first. Make sure your heart is healthy enough to have sex. If you have chest pain, nausea, or other discomforts during sex, seek medical help right away.

In the rare event of an erection lasting more than four hours, seek immediate medical help to avoid long-term injury.

In rare instances, men who take PDE5 inhibitors (oral erectile dysfunction medicines, including VIAGRA) reported a sudden decrease or loss of vision, or sudden decrease or loss of hearing. It is not possible to determine whether these events are related directly to these medicines or to other factors. If you experience any of these symptoms, stop taking PDE5 inhibitors, including VIAGRA, and call a doctor right away.

The most common side effects of VIAGRA are headache, facial flushing, and upset stomach. Less common are bluish or blurred vision, or being sensitive to light. These may occur for a brief time.

VIAGRA does not protect against sexually transmitted diseases including HIV.

Please see Important Facts for VIAGRA on the following page or visit viagra.com for full prescribing information.

For free information, including questions to ask your doctor, call 1-888-4VIAGRA (1-888-484-2472).

VIAGRA®
(sildenafil citrate) tablets

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.FDA.gov/medwatch or call 1-800-FDA-1088.

VGU00565E ©2009 Pfizer Inc. All rights reserved.

IMPORTANT FACTS

VIAGRA®
(sildenafil citrate) tablets

(vi-AG-rah)

IMPORTANT SAFETY INFORMATION ABOUT VIAGRA

Never take VIAGRA if you take any medicines with nitrates. This includes nitroglycerin. Your blood pressure could drop quickly. It could fall to an unsafe or life-threatening level.

ABOUT ERECTILE DYSFUNCTION (ED)

Erectile dysfunction means a man cannot get or keep an erection. Health problems, injury, or side effects of drugs may cause ED. The cause may not be known.

ABOUT VIAGRA

VIAGRA is used to treat ED in men. When you want to have sex, VIAGRA can help you get and keep an erection when you are sexually excited. You cannot get an erection just by taking the pill. Only your doctor can prescribe VIAGRA.

VIAGRA does not cure ED.

VIAGRA does not protect you or your partner from STDs (sexually transmitted diseases) or HIV. You will need to use a condom.

VIAGRA is not a hormone or an aphrodisiac.

WHO IS VIAGRA FOR?

Who should take VIAGRA?

Men who have ED and whose heart is healthy enough for sex.

Who should NOT take VIAGRA?

- If you ever take medicines with nitrates:
 - Medicines that treat chest pain (angina), such as nitroglycerin or isosorbide mononitrate or dinitrate
- If you use some street drugs, such as "poppers" (amyl nitrate or nitrite)
- If you are allergic to anything in the VIAGRA tablet.

BEFORE YOU START VIAGRA

Tell your doctor if you have or ever had:

- Heart attack, abnormal heartbeats, or stroke
- Heart problems, such as heart failure, chest pain, or aortic valve narrowing
- Low or high blood pressure
- Severe vision loss
- An eye condition called retinitis pigmentosa
- Kidney or liver problems
- Blood problems, such as sickle cell anemia or leukemia
- A deformed penis, Peyronie's disease, or an erection that lasted more than 4 hours
- Stomach ulcers or any kind of bleeding problems

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal products. Tell your doctor if you take or use:

- Medicines called alpha-blockers to treat high blood pressure or prostate problems. Your blood pressure could suddenly get too low. You could get dizzy or faint. Your doctor may start you on a lower dose of VIAGRA.
- Medicines called protease inhibitors for HIV. Your doctor may prescribe a 25 mg dose. Your doctor may limit VIAGRA to 25 mg in a 48-hour period.
- Other methods to cause erections. These include pills, injections, implants, or pumps.

POSSIBLE SIDE EFFECTS OF VIAGRA

Side effects are mostly mild to moderate. They usually go away after a few hours. Some of these are more likely to happen with higher doses.

The most common side effects are:

- Headache
- Feeling flushed
- Upset stomach

Less common side effects are:

- Trouble telling blue and green apart or seeing a blue tinge on things
- Eyes being more sensitive to light
- Blurred vision

Rarely, a small number of men taking VIAGRA have reported these serious events:

- Having an erection that lasts more than 4 hours. If the erection is not treated right away, long-term loss of potency could occur.
- Sudden decrease or loss of sight in one or both eyes. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. They may be caused by conditions like high blood pressure or diabetes. If you have sudden vision changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Sudden decrease or loss of hearing. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. If you have sudden hearing changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Heart attack, stroke, irregular heartbeats, and death. We do not know whether these events are caused by VIAGRA or caused by other factors. Most of these happened in men who already had heart problems.

If you have any of these problems, stop VIAGRA. Call your doctor right away.

HOW TO TAKE VIAGRA

Do:

- Take VIAGRA only the way your doctor tells you. VIAGRA comes in 25 mg, 50 mg, and 100 mg tablets. Your doctor will tell you how much to take.
- If you are over 65 or have serious liver or kidney problems, your doctor may start you at the lowest dose (25 mg).
- Take VIAGRA about 1 hour before you want to have sex. VIAGRA starts to work in about 30 minutes when you are sexually excited. VIAGRA lasts up to 4 hours.

Don't:

- Do not take VIAGRA more than once a day.
- Do not take more VIAGRA than your doctor tells you. If you think you need more VIAGRA, talk with your doctor.
- Do not start or stop any other medicines before checking with your doctor.

NEED MORE INFORMATION?

- This is only a summary of important information. Ask your doctor or pharmacist for complete product information OR
- Go to www.viagra.com or call (888) 4-VIAGRA (484-2472).

Uninsured? Need help paying for Pfizer medicine? Pfizer has programs that can help. Call 1-866-706-2400 or visit www.PfizerHelpfulAnswers.com.



Distributed by:
Pfizer Labs
Division of Pfizer Inc, NY, NY 10017

Rx Only ©2007 Pfizer Inc. All rights reserved. Printed in the USA.
VGIF Rev 4 12/07

Registered trademarks are the property of their respective owners.

helpful
answers

POINTER: The beam's original diameter is only about 12 inches, but it spreads to 12 miles by the time it intercepts the LRO.

Laser Marksmanship

A QUARTER-MILLION-MILE BEAM OF LIGHT PINPOINTS AN ORBITER CIRCLING THE MOON.

➔ **Astronauts will need** excellent maps to safely explore the moon. One unexpected boulder or incline could disable a lander or rover—and possibly ruin a multi-billion-dollar mission. NASA launched the Lunar Reconnaissance Orbiter (LRO) last June to chart the landscape in unprecedented detail. Mapmakers on Earth need to know the LRO's exact location as it spins around the moon at 3600 mph, but conventional tracking methods that use microwaves are only accurate to within about 65 feet. To get a better fix, researchers at Goddard Space Flight Center in Maryland are locating the orbiter with a laser that flickers 28 times a second. An onboard detector records each pulse's arrival and radios that

information to Earth, enabling the researchers to calculate the position of the LRO, 250,000 miles away, to within 4 inches. — A. H.

NO TRICK PHOTOGRAPHY OR DIGITAL MANIPULATION WAS USED, SAYS THOMAS ZAGWODZKI, WHO CAPTURED THIS IMAGE FOR NASA.

CAMERA: Olympus SP-565 UZ, 10-mega-pixel digital. **EXPOSURE:** 15 seconds, midrange F-stop. **CONDITIONS:** Fog helped make the beam visible.

EVERY CAR A METEOROLOGIST + The highway of the future will run on data from the cars that drive on it. Modern cars have sensors that collect environmental information, including temperature and barometric pressure, but the data is never used beyond the vehicle. That would change under the IntelliDrive Initiative, the U.S. Department of Transportation's research effort into smart roadways. Researchers are developing a real-time network that reports conditions by enabling cars to automatically communicate with each other and with road infrastructure via 5.9-GHz transceivers. Vehicles would broadcast local temperature and the time and speed at which their windshield wipers are turned on. Road slickness could be inferred by the activation of antilock brakes and electronic stability control. The IntelliDrive network may be working by 2014. — DAN CARNEY



Made-to-Order Offspring

INCREASINGLY SOPHISTICATED GENETIC TESTS MAKE IT POSSIBLE FOR PARENTS TO CHOOSE THEIR BABY'S TRAITS. BY AMBER ANGELLE

→ For just an extra few thousand dollars, women undergoing in vitro fertilization (IVF) could one day choose to have a baby boy with perfect vision, an aptitude for sports and a virtual lock on avoiding colon cancer. Fertility clinics in the U.S. currently offer not only to screen for diseases, but also to choose gender. They are not yet offering any further customization, but that could change as genetic mapping gets faster and easier. Last year, a California company said it could screen for hair and skin color, but soon retracted the claim amid a firestorm of protest. (Research like this has prompted Pope Benedict to condemn "the obsessive search for the perfect child.") The best screening test on the market is called preimplantation genetic diagnosis. PGD, developed to

prevent births of children with severe disorders, screens chromosomes from one or two of an embryo's cells for abnormalities. Depending on the results, the IVF embryo is either implanted in the mother, donated for research or destroyed. Now, researchers at the privately run Genetics & IVF Institute in Virginia have developed a test called karyomapping. The new procedure compares the genetic maps of parents and embryos to detect 15,000 known genetic disorders. It could also be used to choose traits including intelligence or skin color. "The future of genetic screening will really depend on what people want," Elizabeth Ginsburg, the former president of the Society for Assisted Reproductive Technology, says. "If that means creating so-called designer babies, we're going to need a lot more regulation."

through PGD embryo screening. A new technique in clinical trials may offer a less expensive method. Originally developed by the U.S. Department of Agriculture for use in cattle, the new method analyzes sperm color and fluorescence to sort male chromosomes from larger female ones.

Disease-Free Guarantee
→ Parents with a family history of diseases such as cystic fibrosis, sickle cell anemia and muscular dystrophy have a significant chance of passing the gene mutation that causes the disease on to their children. PGD can screen embryos for those conditions. It can also screen for genes that don't guarantee illness, but which are associated with higher risks of breast and colon cancer and Alzheimer's disease.

THREE WAYS BABIES ARE BORN TO SPECIFICATIONS

Savior Siblings

→ Parents with children who suffer from leukemia or anemia and who could benefit from stem cell treatment can order up a sibling with the right genetic material. DNA from an embryo is analyzed to find a human leukocyte antigen gene match between an embryo and the child. Nine months later, when the baby is born, the stem cells are retrieved from umbilical cord blood.

Pink or Blue

→ A 2006 survey conducted by the Genetics and Public Policy Center found almost half of U.S. fertility clinics offered non-disease-related sex selection



designer baby: *n.*

A baby whose genetic makeup has been selected in order to remove a particular defect, or to ensure that a particular gene is present.

— Oxford American Dictionary

YOU



TREE-GRUB BRÛLÉE.

IN?



THE FIFTH GENERATION
4RUNNER

The all-new Fifth Generation 4Runner with reclining fold-flat second-row seat and improved driver comfort. Not that you need to be pampered, you element-hardened, modern-day Davy Crockett. Find out more at TOYOTA.COM/4RUNNER

U.S. GOV'T GOLD AT-COST

TODAY - The United States Rare Coin & Bullion Reserve has scheduled the final release of U.S. Gov't Issued \$5 Gold Coins previously held at the U.S. Mint at West Point. These Gov't Issued Gold Coins are being released on a first-come, first-serve basis, for the incredible markup-free price of \$128 each. This "at-cost" Gov't Gold offer could be cancelled at any time. Do not delay. Call a Sr. Gold Specialist today.

OWN GOV'T ISSUED GOLD COINS

*DUE TO STRICT LIMITED AVAILABILITY, TELEPHONE ORDERS
WILL BE ACCEPTED ON A FIRST-COME, FIRST-SERVE BASIS
ACCORDING TO THE TIME AND DATE OF THE ORDER.*

Markup-Free Price of ONLY

\$128⁰⁰
EACH



If you've been waiting to move your hard-earned money into precious metals, the time is now to consider transferring your U.S. dollars into United

States Government Gold. The Gold market is on the move, up nearly 270% over the past 9 years - outpacing the DOW, NASDAQ and S&P 500. Call immediately to order your United States Gold Coins direct from our Main Vault Facility, "at-cost", for the amazing price of only \$128 per coin. Special arrangements can be made for Gold purchases over \$50,000. Order your Gold today!

1 - Gov't Issued Gold Coin	\$ 128.00
5 - Gov't Issued Gold Coins	\$ 640.00
10 - Gov't Issued Gold Coins	\$ 1,280.00

AT-COST OFFER LIMITED TO PURCHASES OF 10 COINS (\$1,280) PER HOUSEHOLD PLUS SHIPPING & INSURANCE. MINIMUM ORDER 5 GOLD COINS.

CALL TOLL FREE (24 Hours A Day, 7 Days A Week)

1-800-282-1931

MASTERCARD • VISA • AMEX • DISCOVER • CHECK

UNITED STATES
RARE COIN & BULLION RESERVE
Distributor of Government Gold. Not affiliated with the U.S. Government.

Vault No. PM4-128

Coins enlarged
to show detail.



Upgrade

Cool Breeze

➔ A fan with no blades? ***The Dyson Air Multiplier Fan*** (\$300 for the 10-inch model, \$330 for the 12-inch) does away with spinning spokes. How it works: The machine sucks air into its base before forcing it up around the hoop and through narrow slits. To beef up the breeze, it sucks in extra air from the back, side and front of the fan. The advantage: even airflow, no blades to clean and an unlimited number of speed settings (most fans have only two or three modes). But seriously, if you are that concerned with the shortcomings of a fan, you've probably already bought an air conditioner. The real magic of this thing is its ability to induce "oohs" and "aahs" when you stick your hand through the hoop. And we cannot wait until they build this tech into a large sci-fi ceiling fan. — **SETH PORGES**

Light Torch

→ The **Bernzomatic QuickFire Hand Torch (\$70)** eschews common 14-ounce propane tanks for shrunk 5.45-ounce canisters. The advantages: a lighter, smaller rig that is easier to slip into tight spaces, and a higher center of gravity that helps ward off fatigue. Sure, you may need to swap tanks a bit more often, but 5.45 ounces is plenty for most jobs, short of sweating together a whole-home heating system.



Shop Shooter

→ What with unstable surfaces, sawdust-filled air and power tools aplenty, the average work site is just about the last place you'd want to bring a fragile camera. The ruggedized **Ryobi DuraShot 8-Megapixel Camera (\$200)** is designed specifically to handle a work site's hazards. It's dustproof, drop-proof and waterproof. It's also got a built-in voice recorder, and it's the only camera we've ever seen that can borrow a battery from a power tool—it uses Ryobi's Tek4 4-volt system.



Future Watch

SOLAR-POWERED CELLPHONES

Integrated solar panels



→ In our experience, solar-powered gadget chargers are good for camping, but hauling them around for everyday use isn't worth the trouble. A possible solution: integrated solar panels, like the ones built into the **Samsung Blue Earth Phone**, which was recently released in Europe and could be coming to the U.S. soon. These solar cells might make the phone seem like an environmental trailblazer, but it takes 15 hours of sunlight to fully charge the phone's battery. This anemic draw makes the integrated panels useful only as a backup power supply.



You'll never forget that day.

PLAVIX can help keep you from going through it again.



PLAVIX can help save lives for those who've had a heart attack caused by a completely blocked artery.

Without PLAVIX



Clots that block off arteries are the main cause of heart attack. And now that you've had a heart attack you are at a greater risk of having another that can be fatal. That's why your doctor may put you on PLAVIX, along with your

other heart medicines. Taking PLAVIX with your other heart medicines goes beyond what other heart medicines alone can do to keep blood platelets from sticking together and forming dangerous clots.

With PLAVIX



Important Safety Information: If you have a stomach ulcer or other condition that causes bleeding you should not use PLAVIX. Taking PLAVIX alone or with some other medicines including aspirin may increase bleeding risk. Tell your doctor before planning surgery or taking aspirin or other medicines with PLAVIX, especially if you've had a stroke. Some medicines that are used to treat heartburn or stomach ulcers, like Prilosec, may affect how PLAVIX works, so tell your doctor if you are taking other medicines. If fever, unexplained weakness or confusion develops, tell your doctor promptly. These may be signs of TTP, a rare but potentially life-threatening condition, reported sometimes less than 2 weeks after starting PLAVIX. Other rare but serious side effects may occur.

Ask your doctor how PLAVIX can help increase your protection against future heart attack, stroke, and even death. To learn more about heart attacks and PLAVIX, visit www.plavix.com or call 1-800-463-6920.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088. See important product information on the following page.

If you need help paying for prescription medicines, you may be eligible for assistance. Call 1-888-4PPA-NOW (1-888-477-2669), or go to www.ppaix.org



Partnership for
Prescription Assistance

PLAVIX

(clopidogrel bisulfate) tablet, film coated

Rx Only

WHO IS PLAVIX FOR?

PLAVIX is a prescription-only medicine that helps keep blood platelets from sticking together and forming clots.

PLAVIX is for patients who have:

- had a recent heart attack.
- had a recent stroke.
- poor circulation in their legs (Peripheral Artery Disease).

PLAVIX in combination with aspirin is for patients hospitalized with:

- heart-related chest pain (unstable angina).
- heart attack.

Doctors may refer to these conditions as ACS (Acute Coronary Syndrome).

Clots can become dangerous when they form inside your arteries. These clots form when blood platelets stick together, forming a blockage within your arteries, restricting blood flow to your heart or brain, causing a heart attack or stroke.

WHO SHOULD NOT TAKE PLAVIX?

You should NOT take PLAVIX if you:

- are allergic to clopidogrel (the active ingredient in PLAVIX).
- have a stomach ulcer
- have another condition that causes bleeding.
- are pregnant or may become pregnant.
- are breast feeding.

WHAT SHOULD I TELL MY DOCTOR BEFORE TAKING PLAVIX?

Before taking PLAVIX, tell your doctor if you're pregnant or are breast feeding or have any of the following:

- gastrointestinal ulcer
- stomach ulcer(s)
- liver problems
- kidney problems
- a history of bleeding conditions

WHAT IMPORTANT INFORMATION SHOULD I KNOW ABOUT PLAVIX?

TTP: A very serious blood condition called TTP (Thrombotic Thrombocytopenic Purpura) has been rarely reported in people taking PLAVIX. TTP is a potentially life-threatening condition that involves low blood platelet and red blood cell levels, and requires urgent referral to a specialist for prompt treatment once a diagnosis is suspected. Warning signs of TTP may include fever, unexplained confusion or weakness (due to a low blood count, what doctors call anemia). To make an accurate diagnosis, your doctor will need to order blood tests. TTP has been reported rarely, sometimes in less than 2 weeks after starting therapy.

Gastrointestinal Bleeding: There is a potential risk of gastrointestinal (stomach and intestine) bleeding when taking PLAVIX. PLAVIX should be used with caution in patients who have lesions that may bleed (such as ulcers), along with patients who take drugs that cause such lesions.

Bleeding: You may bleed more easily and it may take you longer than usual to stop bleeding when you take PLAVIX alone or in combination with aspirin. Report any unusual bleeding to your doctor.

Geriatrics: When taking aspirin with PLAVIX the risk of serious bleeding increases with age in patients 65 and over.

Stroke Patients: If you have had a recent TIA (also known as a mini-stroke) or stroke taking aspirin with PLAVIX has not been shown to be more effective than taking PLAVIX alone, but taking aspirin with PLAVIX has been shown to increase the risk of bleeding compared to taking PLAVIX alone.

Surgery: Inform doctors and dentists well in advance of any surgery that you are taking PLAVIX so they can help you decide whether or not to discontinue your PLAVIX treatment prior to surgery.

Genetics: People with a specific genetic makeup may get less protection against future cardiovascular events, such as a heart attack or stroke, with Plavix.

WHAT SHOULD I KNOW ABOUT TAKING OTHER MEDICINES WITH PLAVIX?

You should only take aspirin with PLAVIX when directed to do so by your doctor. Certain other medicines should not be taken with PLAVIX. Be sure to tell your doctor about all of your current medications, especially if you are taking the following:

- aspirin
- nonsteroidal anti-inflammatory drugs (NSAIDs)
- warfarin
- heparin
- heartburn or stomach ulcer medicines, like Prilosec

Be sure to tell your doctor if you are taking PLAVIX before starting any new medication.

WHAT ARE THE COMMON SIDE EFFECTS OF PLAVIX?

The most common side effects of PLAVIX include gastrointestinal events (bleeding, abdominal pain, indigestion, diarrhea, and nausea) and rash. This is not a complete list of side effects associated with PLAVIX. Ask your doctor or pharmacist for a complete list.

HOW SHOULD I TAKE PLAVIX?

Only take PLAVIX exactly as prescribed by your doctor. Do not change your dose or stop taking PLAVIX without talking to your doctor first.

PLAVIX should be taken around the same time every day, and it can be taken with or without food. If you miss a day, do not double up on your medication. Just continue your usual dose. If you have any questions about taking your medications, please consult your doctor.

OVERDOSAGE

As with any prescription medicine, it is possible to overdose on PLAVIX. If you think you may have overdosed, immediately call your doctor or Poison Control Center, or go to the nearest emergency room.

FOR MORE INFORMATION

For more information on PLAVIX, call 1-800-633-1610 or visit www.PLAVIX.com. Neither of these resources, nor the information contained here, can take the place of talking to your doctor. Only your doctor knows the specifics of your condition and how PLAVIX fits into your overall therapy. It is therefore important to maintain an ongoing dialogue with your doctor concerning your condition and your treatment.

Distributed by:

Bristol-Myers Squibb/Sanofi Pharmaceuticals Partnership
Bridgewater, NJ 08807

PLAVIX® is a registered trademark.

CLO-BSCW-SAW-JUL09

Revised: July 2009



Store and Stream

→ If you're looking to cut your cable service, the ability to easily play downloaded videos on your TV is key. When you pop a compatible external hard drive into the **Seagate FreeAgent Theater Plus (\$150)**

TV-connected dock, it streams a drive's full of movies directly to your set. Why we like it: Unlike some nitpicky set-top boxes, it can play virtually any file type. And, unlike its standard-definition predecessor, it plays 1080p high-definition.



Rotary Club

→ In terms of sheer versatility, few tools can match the classic Dremel rotary tool and its arsenal of attachments—they're adept at everything from removing rust to precision grinding and cutting metal. Now the standby gets an upgrade. The **Dremel 4000 High-Performance Rotary Tool (\$150)** has a more powerful motor, an easier-to-use speed-control dial and a more comfortable grip.



Getting the Lead Out

A NEW LAW AIMED AT SCRUBBING LEAD FROM STORE SHELVES MAY HAVE UNWELCOME EFFECTS.

Chalk this one up to the rule of unintended consequences: After 2007's tainted-toy epidemic, Congress quickly passed the Consumer Product Safety Improvement Act of 2008, a law aimed at scrubbing lead from products marketed primarily for children ages 12 and under, such as toys, clothing and bicycles. But the far-reaching law may do more than get unsafe toys off the market. It may also put some toymakers out of business.

In short, the law bans products that contain lead in concentrations of 300 parts per million or more in places that can easily be touched by a child. In order to prove that a toy is lead-free, toymakers must spend \$300 to \$4000 per product in tests—an amount of little consequence to big companies but a major cost for small-batch, independent toymakers. "People who do this as a hobby are done," says toy seller Dan Marshall, who founded the Handmade Toy

Alliance last year to oppose the CPSIA.

The law could also cause makers of essentially harmless products to move overseas to avoid the regulation. "Why not go where we're wanted?" Ian Smith, president of OSET dirt bikes, says. His company's kid-size bikes contain small amounts of lead in the brake levers. Smith recently moved his business from Denver to England.

For its part, the Consumer Product Safety Commission, tasked with enforcing the CPSIA, says that the law can be implemented flexibly, and notes that it doesn't affect products that may simply fall into the hands of children—such as ballpoint pens. "We want to find practical ways to keep small businesses open," Scott Wolfson, a spokesman for the CPSC, says. And the commission may be giving small toymakers a stay of execution: It has postponed until February 2010 the deadline for testing and certification to begin. — JOE P. HASLER

Abusive Lab Test

CONTRACTOR
GARBAGE
BAGS

→ We have to be able to trust our garbage bags. After all, their thin skins are all that stands between our floors and a gruesome concoction of trash, glass and ooze. We tested three contractor garbage bags: a 2-mil and two 3-mils—one of which was made of biodegradable recycled plastic—to see the difference a mil of thickness makes. **BY HARRY SAWYERS**

the
bags

Hefty 2-mil (\$10 for 18 bags)
Grip-Rite 3-mil (\$15 for 20 bags)
EconoGreen 3-mil (\$17 for 30 bags)

Slate Pavers

Sander

the
tests

WEIGHT CAPACITY

We started with a 20-pound slate paver and added weights until the bags burst.

+

HEFTY 2-MIL:

The thin, stretchy resin held until the load hit 40 pounds.

GRIP-RITE 3-MIL:

Despite being thicker than the Hefty, it actually held less weight—a tear appeared at just 35 pounds.

ECONOGREEN 3-MIL:

Our strongest bag stood up to two testers hauling 65 pounds of weight before it finally tore.

WINNER: EconoGreen

ABRASION RESISTANCE

To simulate dragging a bag over pavement, we used 220-grit sandpaper and a 5-inch random-orbital sander to bore holes in taut plastic.

+

HEFTY 2-MIL:

Dime-size holes emerged in the Hefty after 5 seconds of intense sanding.

GRIP-RITE 3-MIL:

This bag's glossy finish seemed to act like a protective layer—it took a full 12 seconds to sand through the sack.

ECONOGREEN 3-MIL:

The bag's coarse finish seemed to work against the bag, as it gave the sander something to bite. We were shredding through the plastic after only 2 seconds.

WINNER: Grip-Rite

PUNCTURE RESISTANCE

We jammed the bags full of pointy broken branches, tied them tight and counted how many twigs poked through.

+

HEFTY 2-MIL:

Our thinnest bag proved the most puncture-prone, with seven sticks poking through the membrane.

GRIP-RITE 3-MIL:

Despite thick sides, the Grip-Rite allowed six sticks to pop through.

ECONOGREEN 3-MIL:

Skeptics contend that recycled plastic makes for inferior bags. This bag proves them wrong. Our most puncture-proof bag let only three sticks through.

WINNER: EconoGreen

BOTTOM LINE

The EconoGreen's strong showing proved that a recycled and biodegradable bag can be as tough as one made from virgin plastic. But if you often drag trash over concrete, reach for the Grip-Rite.

Feel Like You're Defying Gravity...

GUARANTEED! Imagine not being tired anymore... Imagine being pain free and filled with energy...



ABSORB SHOCK
Eliminate pain from every step.



REBOUND PROPELS YOU FORWARD
Reduce fatigue. Be more active



...Stop Imagining

Walk and run faster, jump higher, no fatigue and no more pain!

Should G-Defy be banned from Athletic Competition?

They might be considered an unfair advantage.

Genesis of Athletic Excellence

Elevate your game to the next level. Feel the drive, the inspiration, the energy as you slip your feet into the most exhilarating shoes in the world! Go from the week-end warrior to the daily champion at your gym and on the street.

Smart Spring Technology

Within 10 days of regular use, the special combination of space age rubber and lightweight, durable springs will adjust to your activities and begin to improve your overall comfort. Give your whole body a break from the stress of your high impact life and experience breakthroughs in your athletic lifestyle. Be in action. Be unstoppable. Be comfortable and live pain free.



Clinical Study - Study conducted of 152 Gravity Defyer customers... 73% male and 27% female.



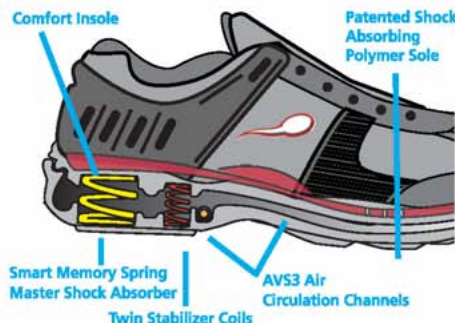
Great News for the Overweight?

Extra weight puts an added toll on your bones and joints. Running isn't an option, and walking can become difficult. G-Defy Shoes will take the pressure from your large frame body, make you more active and change your life forever!

Ease Joint Pain!

You will notice immediate relief of common pain during exercise as the springs of G-Defy athletic shoes absorb most of the impact - instead of your body - by easing the stress on your joints, back and neck while walking, running, or jumping.

- Relieve all pains
- Ease joint & spine pressure
- Reduce fatigue & tiredness
- Be more active
- Have more energy
- Appear taller
- Jump higher, walk and run faster
- Have instant comfort
- Cool your feet & reduce foot odor
- Elevate your performance



~~\$129.95~~ **\$119.95** with coupon code

TB902MBL Men's Black TB902FWS Women's White
TB902MW Men's White TB902FB Women's Black
sizes 7.5 - 13.0 sizes 6.0 - 11.0
widths D/W or 2E/4E widths B/D or 2E/3E

Try them FREE for 30 Days!
(your card will not be billed)

Order your G-Defy Athletic Shoes today for only \$119.95 (You save \$10) at www.gdefy.com/MC8ABT or call (800) 429-0039 and mention offer code: MC8ABT

**100% Satisfaction Guaranteed,
Nothing to Lose -but your pain.**

30 Day Money Back Guarantee. If not satisfied, send them back for a full refund of purchase price.

gravity defyer
SPRING TECHNOLOGY FOOTWEAR

Distributors and dealers please call 818 501 5277



Football Iron

→ Now why didn't we think of that? When we iron, we iron pointy end forward in order to navigate around buttons and minimize crumpling. But if an iron had two pointy ends ... well, you get the picture. The football-shaped **Panasonic 360 Quick Iron (\$50)** has two acute tips—a design the company claims cuts ironing time by a quarter.

Q+A

NINTENDO'S
SHIGERU
MIYAMOTO



THE MIND OF NINTENDO VISIONARY **SHIGERU MIYAMOTO** HAS GIVEN BIRTH TO SO MANY CLASSIC VIDEO GAMES AND CHARACTERS, IT'S NO UNDERSTATEMENT TO CALL HIM THE FATHER OF MODERN GAMING. FOR HIS LATEST GAME, *NEW SUPER MARIO BROS. WII*, THE 57-YEAR-OLD MIYAMOTO ADDED A PARTY-FRIENDLY FOUR-PERSON MULTIPLAYER MODE TO THE SIDE-SCROLLING, COIN-COLLECTING GAMEPLAY THAT FIRST MADE THE SERIES FAMOUS. WE SAT DOWN WITH THE CREATOR OF MARIO, ZELDA AND DONKEY KONG TO TALK ABOUT THE PAST AND FUTURE OF GAMING, AND TO TAKE HIM ON IN THE NEW GAME (HE SOUNDLY DESTROYED US).



The nostalgia-inducing, side-scrolling action of the *New Super Mario Bros. Wii* should be familiar to fans of the classic Mario games. The difference? Up to four players can now simultaneously run, jump and dive down pipes in pursuit of coins—and the princess.

PM: How did you create Mario? When was it decided that he should be a plumber?

→ The story of creating Mario goes all the way back to *Donkey Kong*, where he first appeared. With the technology back then, you had a very limited palette in which you were able to draw a character. If you look at the original Mario, you had just seven pixels to draw his face. My goal within that limited palette was to create a character that was as distinct as possible. Because of that, he had some of his now-distinct features, such as his big nose.

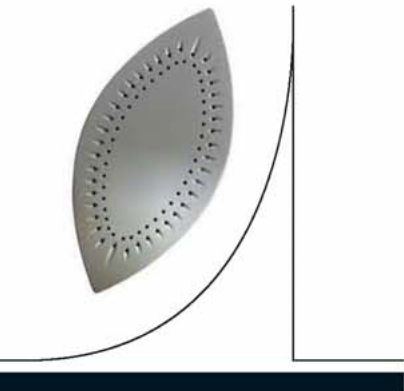
At first, I kind of looked at Mario as your average, everyday foolish guy. The setting of *Donkey Kong* was a construction site, so I kind of matched him with the setting of the game, and decided in that game that he was a carpenter. And then we made the original *Mario Bros.* game, which was the first game that had pipes in it. Looking at the setting of that game, it had the feeling of, like, an underground New York sewer system. And so I thought: What kind of guy would be there working on the pipes? A plumber!

PM: After playing these games, we have to wonder: Did anybody ever throw barrels or fireballs at you when you were growing up?

→ Nobody ever threw barrels at me, but I did read a lot of manga comics in Japan and see a lot of cartoons and you'd often see silly things like that happening.

PM: Do you create background stories for the characters that maybe aren't known to the public or presented in the games?

→ For the most part we don't create very in-depth back stories for the characters. I think the *Zelda* games and *Ocarina of Time* in particular may be somewhat different in that we did think heavily about who are all the characters in the world, and what is their relationship to one another, and how does that play out in the story. But taking games like the *Super Mario Bros.* series in particular, typically when we design a character it's based on their function within the interactive gameplay world. So, for example, characters that have spikes are characters you cannot jump on. In that sense it's not so much designing a character as it is designing their function within the world.



PM: Where do you see the future of video games?

→ Video-game systems were originally viewed as a toy, and they were something you played with. Now I think we're starting to see a blurring of the lines, where video games are moving beyond simply entertainment into other aspects of everyday life. And I think what video games benefit from is an intuitive interface that's easy to understand, with a controller that is maybe a little bit more familiar and easier to use than the interface of a typical computer. As time goes on, I think we're going to see the video-game console and this interactive interface gradually bleed into other elements of home electronics and daily life. For example, in Japan the Wii itself has a TV guide channel that Wii owners can download. And for a lot of people in Japan who own a Wii, that TV guide channel is a lot more convenient and easier to use than a typical TV guide service.

PM

Wrangler

FIVE STAR
Premium Denim

BRETT FAVRE
AT HOME IN WRANGLER RELAXED FIT

Brett Favre

YOU CAN COUNT ON WRANGLER.
COMFORT. QUALITY. VALUE.

Available at
Walmart
Save money. Live better.

Wrangler

Real. Comfortable. Jeans.

HOLIDAY GIFT GUIDE

Gadget engraving is just the beginning...

From creating unique projects like architectural models to engraving on high-tech gadgets, our laser systems provide a wide variety of capabilities. Create all the products you see here with one very versatile laser system.

- Zing 24, 30-60 watt laser - 24" x 12" engraving area
- Works like a printer - USB or Ethernet connection
- Engrave on almost any surface
- Easily cut wood, acrylic, plastic and much more
- Just import an image and print it to the laser



The Zing 24 Laser System



All it takes is one idea.

Zing Systems Starting at \$7,995!

Visit www.epiloglaser.com/popmech.htm for more information!

1.888.437.4564 • sales@epiloglaser.com

MADE IN USA



Overwhelm Your Favorite Driver

Radar, Laser
and Safety
Camera Detector



This year, give that special driver something they'll use every day—the new **PASSPORT 9500ix** radar, laser and safety camera detector from ESCORT.

It provides the best long-range warning against every known threat, including red light and fixed position speed cameras using GPS technology.

Order today and we'll extend our 30-day Holiday Money-Back Guarantee until January 31, 2010!



THE RADAR AND LASER EXPERTS

www.EscortRadar.com Call 800.852.6258

PASSPORT 9500ix Blue \$499.⁹⁵ +S&H (OH res. add tax)

► Department PMECH

TURN TO A PRO THIS PLOW SEASON: THE WARN PROVANTAGE PLOW SYSTEM

The WARN® ProVantage ATV and Side X Side plow systems have been designed from the ground up to be the most versatile, durable, and high-performance plow system on the market. It's easy to connect. It's heavy-duty. It's engineered to perform. And with a variety of useful, innovative accessories, it's the most complete plow system money can buy.



Connection is easy —
no tools, no hassles,
and no more crawling
under the vehicle




TO LEARN MORE OR FIND A DEALER NEAR YOU, GO TO: WWW.WARN.COM

GET IN THE GIFT GIVING SPIRIT WITH THE MOST-WANTED GEAR FOR THIS HOLIDAY SEASON. BECAUSE WHO NEEDS ANOTHER TIE OR PAIR OF SOCKS?

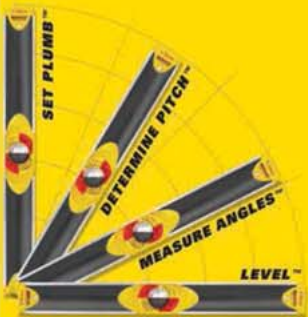
CH. HANSON
Since 1866 - Tools for Generations™

PRECISION BALL LEVEL™

EASIER TO READ THAN A BUBBLE™



➤ **LEVEL™** ➤ **ANGLE/PITCH™** ➤ **PLUMB™**



Forget looking for the bubble - the new **Precision Ball Level™** makes measuring level a quick and simple process. In addition, measuring angles/pitches and determining plumb is a breeze with the level's aviation inspired technology - technology which can measure in any two directions at the same time. Simply put the Precision Ball Level is a better more useful tool.

NOW AVAILABLE AT **LOWE'S** www.hansonlevel.com

CarMD® An essential tool to ensure your vehicle's vitality

CarMD is a great "under \$100" gift that identifies small problems before they grow into expensive repairs. The new CarMD® Handheld Device & Software Kit allows access to enhanced online diagnostic reports and allows free access to a database with real-life fixes from a network of ASE Certified technicians.

Exclusive to Popular Mechanics Readers:
Save 15%
with Promo code: **PMGift09**
(offer good through Jan. 31, 2010)
Buy Now: www.CarMD.com



CarMD®
FOR THE LIFE OF YOUR CAR

Mac Universal Windows


EXERCISE IN EXACTLY 4 MINUTES PER DAY



RENT A QUICKGYM FOR 30 DAYS.
RENTAL APPLIES TO PURCHASE.

818.504.6450
www.quickgyminfo.com

It's time for THE Ultimate Destination!




GOODYEAR

BOB BONDURANT®
SCHOOL OF HIGH PERFORMANCE DRIVING
FIREBIRD RACEWAY • CHANDLER, AZ

1.877.579.RACE
7 2 2 3

bondurant.com



GM The Official High Performance Driving School of General Motors.

HOLIDAY GIFT GUIDE

The Factory Five Racing's New '33 Hot Rod

Complete Package \$19,990

SPEED
As Seen on SPEED TV



Performance engineered by the race car fanatics at Factory Five Racing, the new '33 comes with everything you need to build your car except for engine/transmission/rear end, wheels/tires, and paint. The car is also a great platform for customization with options like our removable hard top and fenders. Designed for high horsepower applications with an ultra-rigid carbon steel tubular frame, modern coil-over suspension, and a period correct composite body. **Call us for a Free DVD/brochure at 508-291-3443 or visit us at www.factoryfive.com.**



Free DVD/brochure
508-291-3443 or visit
www.factoryfive.com



65 Coupe kit \$14,990



Mk3 Roadster kit \$12,990



GTM Supercar kit \$19,990

Wideband : WiFi



Innovate Motorsports, manufacturer of the world's first digital air/fuel ratio meter has developed a simple interface that allows you to use your Apple iPhone® or iPod Touch® to communicate via Wi-Fi with your vehicle's engine computer (ECU), OBDII 1996 and up. This gives you the ability to: View and record Vehicle Efficiency (MPG), Performance Dyno, Analyze critical engine parameters, View and clear Check Engine Lights, and more!

INNOVATE
MOTORSPORTS

800-348-3037 WWW.TUNEYOUENGINE.COM

HELI PROZ.COM

The Biggest and Best R/C Heli Shop on the Planet!

Have you always dreamed of building and flying a heli? It has never been easier to learn than now.

HeliProz supports all levels of Heli's - from the young beginner all the way up to the most advanced.



Imagine the possibilities - aerial photography, autonomous flight, aerobatics, scale flying, all built by you. Let our highly experienced staff help you make your dreams come true.

Check us out today at HeliProz.com, enter coupon code **POPMECH for 5% off your first order!**

1-877-435-4776

2885 Farley Lane • Billings, MT 59101



SPORT COMPACT + CROSSOVER +
SPORTS CAR + PICKUP TRUCK



New Cars

Leading Man

The new Terrain could play a key role in kick-starting a GM renaissance. The five-passenger crossover is available with a 2.4-liter four-cylinder or a 3.0-liter V6, both mated to a six-speed automatic. An Eco mode in four-cylinder models recovers nearly 1 mpg—for 32 mpg highway. Inside, we dug the laptop-size bin, and rear seats that can slide 8 inches or fold flat to provide 64 cubic feet of storage. We noticed the deeper grain finishes on the dash, higher quality materials and improved panel tolerances compared to its cousin, the Equinox, during our Michigan drive. The four-cylinder provides mild-mannered thrust. But the Six is strong, with a broad torque curve that keeps the transmission from hunting. If new GM models continue to be executed with the same attention to detail as the Terrain, the company could hit its stride. — **BASEM WASEF**

2010 GMC Terrain

Base Price: \$24,995



Inside



>>PM
TEST
DRIVES

>>FIRST
LOOK



>>FRANKFURT
MOTOR
SHOW
SPECIAL



GMC TERRAIN | BRP CAN-AM SPYDER RT-S
 LAND ROVER LR4 | CHEVY CORVETTE GRAND SPORT
 BMW R1200VS | CADILLAC CTS SPORT WAGON

FORD SUPER DUTY
 TOYOTA 4RUNNER

2010
BRP Can-AM Spyder
RT-S



LAND ROVER
5.0-LITER
V8

2010
Land Rover LR4



3 2011
Ford Super Duty



1

Three-Wheel Motion

Motorcycle touring doesn't always require two wheels. We hit the roads of Quebec on the latest BRP three-wheeler, the RT-S, loaded with about 40 pounds of luggage and a passenger. Right off the line, it felt less gutsy than the standard model. Encumbered with a passenger, cargo and the RT-S's touring hardware, the 100-hp V-twin feels noticeably taxed. Yet the riding position is relaxed and comfortable and prolonged time in the saddle yields no discomfort. While it takes some adjusting for motorcyclists to forget techniques like countersteering and leaning on a three-wheeler, the RT-S has a slightly steeper learning curve. The added weight and large footprint don't inspire frisky moves. Still, the air suspension was easily stiffened and softened using a rocker switch, and the controls for the electronic parking brake and heated handgrips were logically placed. The \$24,999 RT-S isn't cheap. But that three-wheel stability might be worth the price for some long haulers.

— BASEM WASEF

2

Strong Suiter

The scope of every Land Rover's operation envelope is striking. One moment you're cruising at 80 mph on beautifully damped air springs, ensconced in soft leather, the next you're nearly door-handle-deep in liquid mud. The new LR4 we sampled in Scotland recently is just as capable as its forefathers but is now armed with a 375-hp 5.0-liter V8 with 375 lb-ft of torque. The LR4 accelerates to 100 mph and then brakes to a stop before the previous model could even reach 100 mph. This is still a big, heavy vehicle. But the torquey engine, smooth transmission and smart suspension team up to provide poise and agility that belie the 5800-pound avoirdupois. The LR4 is able to glide along the freeways and country lanes with luxury-sedan competence, then pump itself up to crawl the Rubicon Trail. Though at \$48,100, few will likely test that capability. — BARRY WINFIELD

3

HEAD HONCHO

Pickup trucks may be suffering the effects of gyrating fuel prices and a rough economy, but the workhorses of the breed—the heavy-duty trucks—are pulling their weight. And Ford's new 2011 Super Duty promises to pull even more weight, thanks to an all-new 6.7-liter Power Stroke diesel. Though Ford has not yet announced how much thrust this new engine will deliver, we have heard peak torque should climb north of an incredible 700 lb-ft. The Super Duty's base engine is new too; it's the same 6.2-liter V8 that makes 400 hp in the Ford Raptor. A Productivity Screen gives drivers on-demand towing and off-road engagement tips and fuel-economy performance. — BEN STEWART

**Enter now
Time is Running Out!**

Corvette Dream Giveaway

A Dream Giveaway™ sweepstakes

To benefit Kids Wish Network's Hero Program

To enter go to

winthevettes.com

Or call toll free

866-WIN-BOTH

(866-946-2684)



Restored 1967 427/390 HP Corvette Roadster, tuxedo black with red stinger, side exhaust, 4 speed, aluminum wheels. The perfect car to drive or show.



Serial #1 of 1

2009 ZR1 "HERO EDITION" one-of-a-kind 638 horsepower capable of over 200 MPH. A priceless piece of automotive history.

Win Both Incredible Cars and Help Deserving Kids!

Winner will be announced December 25, 2009. All entries must be received and processed by 11:59 PM EST, December 22nd, 2009.



Tony Stewart at the NASCAR track with "Wish Kid" fan, Patrick

Enter online at winthevettes.com or place your order with a live operator at 866-WIN-BOTH (866-946-2684) or mail in completed form below. Credit card orders can be faxed to 317-807-0526

**LAST CHANCE TO ENTER
IS DECEMBER 22!**



2008 Dream Giveaway Winner David Rutherford in his Lingenfelter Corvette.

To learn more about this pair of rare musclecars, Kids Wish Network, Corvette Dream Giveaway or our sponsors, please visit www.winthevettes.com

Yes, I want to help these kids and win both cars!

COMPLETE CREDIT CARD INFO OR MAKE CHECKS PAYABLE TO: Kids Wish Network
P.O. Box 17443
Indianapolis, IN 46217-7443

☐ VISA ☐ MasterCard ☐ DISCOVER ☐ AMERICAN EXPRESS

Name: _____ Phone: _____

Address: _____

City: _____ State: _____ Zip: _____

Card #: _____ Exp: _____ Security Code: _____

☐ Email: _____

No charge for email - receive your tickets and updates fast and FREE!

☐ Mail Tickets Add \$1.95 mail/processing for tickets by mail

☐ I HEREBY CERTIFY THAT I AM 18 YEARS OF AGE OR OLDER
Credit Card Orders may be FAXED TO: 317-807-0526

Kids Wish Network
where dreams really do come true...

A 501(c)(3) Charitable organization
www.kidswishnetwork.org

Use Promo Code: PM0110

<input type="checkbox"/> 1 TICKET	\$3	<input type="checkbox"/> 240 TICKETS	\$200
<input type="checkbox"/> 5 TICKETS	\$10	<input type="checkbox"/> 360 TICKETS	\$300
<input type="checkbox"/> 15 TICKETS	\$20	<input type="checkbox"/> 600 TICKETS	\$500
<input type="checkbox"/> 40 TICKETS	\$50	<input type="checkbox"/> 900 TICKETS	\$750
<input type="checkbox"/> 100 TICKETS	\$100	<input type="checkbox"/> 1200 TICKETS	\$1000

Ticket Purchase \$ _____

Mail/Processing: Add \$1.95 (\$0 email)

TOTAL AMOUNT ENCLOSED: _____

Please allow 2 to 3 weeks for mail delivery

DISCLAIMER: DONATION NOT REQUIRED TO PARTICIPATE AND WILL NOT INCREASE YOUR ODDS OF WINNING. Void where prohibited by law. Winner need not be present to win. Winner responsible for all applicable taxes. See official rules for details at www.winthevettes.com.

Comparison

++ VS.

Heavy Hitters

CAN CHEVROLET'S NEW CORVETTE GRAND SPORT TOPPLE BMW'S STALWART M3?
BY LARRY WEBSTER

2010 BMW M3

\$69,275
4.0-liter V8/7Auto-Manual
414
4.61 sec
12.76 sec
@109.82 mph
105.4 ft
22.3 mpg

TESTED PRICE
ENGINE/TRANS
HORSEPOWER
0-60 MPH
QUARTER-MILE

60-0 BRAKING
FUEL ECONOMY

2010 Chevy Corvette Grand Sport

\$64,315
6.2-liter V8/6M
436
4.55 sec
12.63 sec
@114.2 mph
103.2 ft
24.2 mpg

the SPECS

The heart of these sport machines may be V8 engines, but the BMW and the Chevrolet powerplants are vastly different. The M3's is a technological marvel, allowing a hair-raising 8400-rpm rev limit and packing 103.5 hp per liter of displacement. That level of power density wouldn't be out of place in a race car. Our M3 was equipped with the optional \$2900 seven-speed dual-clutch transmission. And drivers can dial the shift speed from couch-potato lazy to rifle quick. There are also adjustments for steering effort, throttle sensitivity and even shock-absorber stiffness. If the M3 is the bleeding-edge tech geek, the Corvette is the old-school barroom brawler. Its V8 uses pushrods and two valves per cylinder like Chevy's original small-block V8—55 years ago. But the throttle response is very quick, and with fewer parts, it's a lighter engine. A six-speed automatic is available, but we chose the standard six-speed manual.

the DRIVE

The M3 is heavier than the Corvette and has less power, so naturally it was outgunned at the dragstrip. However, the M3 does have a launch-control system, so it's the consistency king. But as speeds rise, the Corvette's lighter weight and better aerodynamics widen the gap. The Vette's straight-line speed and higher grip translate into a faster racetrack lap. Out in the wild, the BMW carves corners brilliantly, expertly knifing into apexes. As for the Vette, the Grand Sport is one very crisp and very planted sports car. On the street, you are unlikely to outdrive this chassis. But as good as the Grand Sport may be, it does suffer from a distinctly low-rent interior, especially compared to the luxurious BMW's. The Vette's removable roof creaked and groaned over sharp bumps. In contrast, the BMW's vault-like structure was in another class.

BOTTOM LINE

This was a close call. It's polish versus outright performance, practicality versus the singular mission. Both cars provide, in different ways, the visceral rush that we crave. But the BMW's back seat, beautiful interior and refinement mean we would want to drive the M3 far more often. It's our choice.

GMC TERRAIN | BRP CAN-AM SPYDER RT-S |
HONDA CRF150F | KIA NIRO |
BMW M3 | CHEVY CORVETTE GRAND SPORT |
CADILLAC CTS SPORT WAGON

FORD SUPER DUTY
TOYOTA 4RUNNER

FEIN MULTIMASTER.

The number one tool for remodeling and renovation.

QuickIN tool changing



Comfortable SoftGrip body



Hundreds of accessories



The right kit for everyone



For over 40 years FEIN has been making oscillating tools for professionals and handymen alike. The FEIN MULTIMASTER is the most versatile tool for remodeling and renovation. German engineered and manufactured, the high power motor is designed for heavy duty, continuous use and operator comfort. A wide selection of accessories is available for every application. Change them quickly and easily with the QuickIN tool changing system.

For more information, a free DVD, or to see the complete line at a dealer near you, call **1-800-441-9878** or visit us at **www.feinus.com**.



EXTREME PROTECTION FOR EXTREME WEATHER.



Melts 3X More ICE*

With freeze protection as low as -34°F.

Quickly removes light frost and ice.

Reduces the chance of dangerous re-freeze.

Prestone®

ONLY PRESTONE IS PRESTONE

*Than the leading competitor at 5°F. Tests conducted at Honeywell proprietary cold chamber laboratory.

www.prestone.com

©2009 Honeywell International Inc.

A Honeywell car care product.

P M N E W C A R S

test drives

2010 Cadillac CTS Sport Wagon



PM Test Drive

First Look



2010 Toyota 4Runner

1

2

Practically Stunning
Crossovers may dominate the automotive landscape, but the far cooler way to pack utility into a car chassis is: Use an actual car. Today's sporty wagons are the contrarian family conveyance. And Cadillac's sport wagon is one of the best in class. Mechanically, it differs little from the CTS sedan, offering a choice of rear- or all-wheel drive, two V6 engines and standard six-speed automatic. The 200 pounds of metal and glass behind the rear doors provide 25 cubic feet of stowage and 58 cubic feet with the seat folded. We used the wagon for our weekend chores and found thoughtful touches throughout the cargo area. A concealed area a few inches deep beneath the floor is covered by a clever folding lid that can be propped in different positions to keep smaller items from sliding around. Need to carry even more stuff? The roof rack can be equipped with optional accessories. Best of all, the \$40,485 Caddy offers a luxurious and entertaining driving experience. — KEVIN A. WILSON

TRAIL TESTED
When SUVs became the en vogue family transport vessel two decades ago, manufacturers began to polish the rough edges from these trucks. Eventually that polishing left behind a bright sheen, but with little substance underneath. Toyota has taken the all-new 2010 4Runner back to its roots. The windshield is more upright, the chassis comes from the capable overseas Land Cruiser Prado, and under the hood is a four-cylinder or a 270-hp V6. The most extreme version adds a locking rear diff, the Land Cruiser's Crawl Control system and a Kinetic Dynamic Suspension that can decouple the sway bars for added axle articulation. We can't wait for a drive. — B.S.



GMC TERRAIN | BRP CAN-AM SPYDER RT-S |
LAND ROVER FREAXY CORVETTE GRAND SPORT |
CADILLAC CTS SPORT WAGON |

FORD SUPER DUTY
TOYOTA 4RUNNER

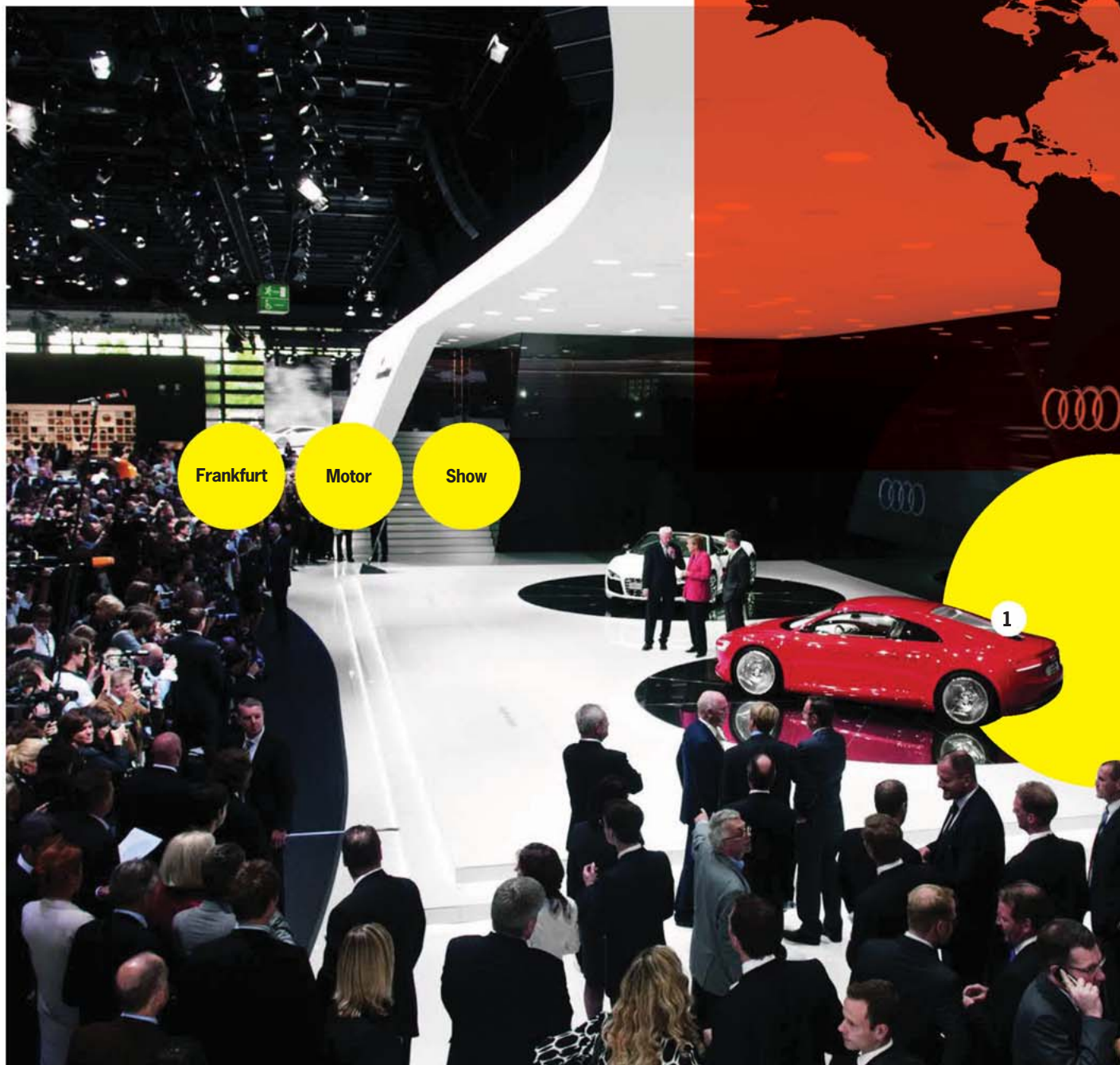
SOME CORNERS YOU JUST DON'T CUT.



These days, it's tempting to try to save a buck or two. But your inner car guy knows your engine is no place to skimp. Just look for the big yellow jug and you're always covered. Prestone® 50/50 Ready-to-Use Extended Life Antifreeze/Coolant is formulated to protect any make or model car, and mixes with any color antifreeze. It's perfectly pre-mixed, so you just pop, pour and protect.

Prestone®

ONLY PRESTONE IS PRESTONE



At September's Frankfurt Motor Show, it seemed that recent economic woes have only served to strengthen the ingenuity of carmakers. The halls were packed with innovation, including mpg-boosting solutions ranging from the right-here-and-now to the distant future. And what of the future of fuel—will plug-in EVs or traditional hybrids win out? Perhaps the most important message at the show was that the traditionally diesel-oriented European manufacturers seemed to have finally embraced electric and hybrid propulsion. Here's a look at some of the most exciting and innovative fuel-efficient cars at the show this year. — JAMES TATE

↑ The buzz at Frankfurt focused on Audi's e-tron Concept sports car—a gorgeous EV that, if built, could challenge the Tesla Roadster.



FRANKFURT, GERMANY

5 TOYOTA PRIUS PLUG-IN HYBRID

↓ The Toyota Prius, undisputed lord of the hybrid vassals, is looking to cement its title with a plug-in variant. A new lithium-ion battery allows the car to travel 12 miles on electric-only power at interstate speeds. Toyota says a special 230-volt charging station will restore the batteries' power, once depleted, in around 1.5 hours. The plug-in hybrid Prius will arrive at Toyota stores in 2012.

6 LEXUS LF-CH HYBRID CONCEPT

↓ Who says hybrids have to look like, well, hybrids? This Lexus concept is a stunner and would compete with cars like the Mini Cooper. The low-slung five-door pulls from Lexus design cues with its angular nose and menacing stance, but so far the company is keeping its lips sealed as to what's under the hood. We hear it uses the hybrid powertrain from the new HS250h—and that it will arrive here next year.

4 VW BLUE-MOTION POLO

↓ VW unleashed a total of three fuel-thrifty compacts at Frankfurt—the stingiest of which is the BlueMotion Polo. A new 75-hp 1.2-liter TDI engine powers the tiny hatchback and delivers an astonishing 61.9 mpg. With the 11.8-gallon fuel tank, you could almost make it from New York City to Chicago on one fill-up of diesel. Sadly, VW doesn't think this car is right for the U.S. As diesel fans, we disagree.

3 MERCEDES-BENZ VISION S500 PLUG-IN HYBRID CONCEPT

↓ This Mercedes makes power from the union of a V6 and a 60-hp electric motor—a combination almost identical to the drivetrain found in the S400 Hybrid. The concept, however, uses a battery with nearly 10 times the capacity. All that extra juice means the Vision S500 can cruise up to 18.6 miles before it needs the engine. Charging is said to take an hour with Benz's at-home system.

2 BMW VISION EFFICIENT-DYNAMICS CONCEPT

↓ A BMW with a radical design, 356 hp and the capability to hit a 0-to-60 mph time of 4.8 seconds isn't surprising. But that this performance comes from a three-cylinder turbodiesel coupled to a plug-in hybrid drivetrain that returns 62.6 mpg at the same time is simply astounding. It seems BMW is ready to combine extreme fuel economy with driving fun.

1 AUDI E-TRON CONCEPT

↓ The proportions of the e-tron are reminiscent of Audi's gorgeous R8 supercar's. And the concept isn't just an all-electric sports car—it employs all-wheel drive; each wheel is powered by its own motor. They generate 313 hp, gobble electrons from a lithium-ion pack and rocket the car to 62 mph in 4.8 seconds. Despite this speed, Audi stresses that the concept has a real-world range of 154 miles.



THE ITALIAN JOBS

> BY JAY LENO
> PHOTOGRAPHS BY JOHN LAMM



Fiat
Millecento
Sedan
1959

Fiat
Topolino
Coupe
1937

Fiat is returning to America, and I'm glad. The merger of Fiat and Chrysler will elevate the Italian brand in this country and create some great cars. Fiat is known in Europe for small, fun, fuel-efficient vehicles—cars Chrysler just does not build.

I own two classic Fiats, a 1937 Topolino coupe, with a tiny 569-cc 13.5-hp four-cylinder, and a 1959 Millecento sedan with an 1100-cc 43-hp engine. In America, that sedan would have been the equivalent of a Ford Fairlane or a low-end Galaxie in terms of its stature in the automotive landscape.

If you were a reasonably successful Italian family man in 1959, the Millecento was the car you would buy; it had four doors, a four-speed shifter on the column, a radio and even a two-speed heater. Oh my God, the options go on and on! Fiat has always been an innovative company.

Fiat introduced the Topolino (little mouse) in 1936—and ultimately sold half a million of them. That Topolino was really the first “people’s car.” The Volkswagen Beetle didn’t come out until after the war. The car has brilliant packaging. It’s tiny,

JAY'S CHARMING VINTAGE FIATS EMBODY THE ROMANCE AND PRACTICALITY OF THE MARQUE.

yet there's so much headroom that someone 6 feet tall wearing a top hat could sit inside. It's one of the few cars in which the generator is bigger than the engine. The radiator is behind the motor so the grille could be made more aerodynamic; you'd never see that on an American car. The Topolino was not powerful. Its top speed was only 53 mph, but it could carry a small family, and I can get close to 50 mpg in my car. Here's the best part: How many car engines can you remove, bring inside the



Legendary Car Builder Carroll Shelby uses zMAX in every personal car and truck he owns.

"I've got my reputation to protect and I wouldn't recommend zMAX unless I knew it worked."

Carroll Shelby

zMAX®, a product developed and made in the USA, is the only one of its kind in the world. zMAX® is a pure Micro-lubricant® that protects against carbon build-up and reduces harmful deposits. For testing information go to www.zmax.com.

- Extends Engine Life
- Increases Horsepower
- Dissipates Engine Heat
- Soaks into Metal
- Will NOT Void Manufacturer's Warranty
- For New and Used Cars
- Reduces Friction
- Improves Gas Mileage
- Reduces Emissions
- Reduces Engine Wear on Vital Engine Parts

Can be used with any motor oil & gas or diesel fuel.



AutoZone

Advance
Auto Parts

PEPPER'S
amazon.com

JEGS
VIP

Fred Meyer
Rural King

CHECKER'S
SCHUCK'S
KRAIGER

MUSKIE
CarParts.com

JC Whitney
cap

Sonic
O'Reilly



zMAX® is the official Micro-lubricant® of Speedway Motorsports, Inc.

This diesel fuel additive complies with the federal low sulfur content requirements for use in diesel motor vehicles and nonroad engines.

JAY LENO'S GARAGE /// CLASSIC FIATS

house, put in your kitchen sink and clean? The Topolino is like a big toy, and it has a sense of style that the VW Beetle never had.

So much about the way a car works has to do with where it's from. Italian cars, especially Fiats and Alfa Romeos, were built to run in a warm climate. It's no surprise that the oil passages tend to be small, because the oil used is so thin. But in freezing New England, you'd get into your Fiat or Alfa, turn the key and the car would moan *whhrrrrrrmmmm, whhrrrrrrmmmm*. And you'd have to press the throttle halfway down three or four times to warm up the car because you're forcing heavy, thick oil through tiny passages. This slow-flowing oil tended to starve the bearings, and a lot of engines in these cars seized prematurely. The trick to owning an Italian car, or any older European car, is to start it, wait 2 minutes, or until the gauges move off their stops, then go.

In Europe, if you owned a car in the '50s and '60s, you were considered a major success. Consequently, you treated your automobile the way you treated your home; it was treasured and taken care of. Whereas in America, at that time, we could buy used cars that actually ran for about 50 bucks. Our cars tended to be a little overbuilt and a lot more durable. We didn't have a "liter tax" on engine size, and we didn't have high gas prices. Our cars had big, heavy, slow-revving (*really* slow-revving) engines that would last forever—or at least 100,000 miles.

European cars were high-revving, and they didn't spend all day on the freeway. If you had told someone in 1959 that a Fiat could run 75 mph for 5 hours straight, all the way from L.A. to Vegas, forget it—they wouldn't have believed you. The thing would



← **The 1959 Millecento** may look bare-bones from inside, but this thrifty sedan was well-equipped for its time and offered hybrid-humblng fuel economy.

↓ **The 1937 Topolino** was tiny, yet even a 6-foot-tall person could fit comfortably inside. The engine's generator was actually larger than the engine itself.

implode. It just wasn't built for the American market, and Fiat sold cars here without Americanizing them. In that sense, they were not very good cars.

In the '50s and '60s, anything built outside our borders was considered suspect and of poor quality. Fiat used low-grade steel, which led to severe rusting. And it didn't have particularly good customer service. A lot of my friends had Fiat 124s from the late '60s and early '70s. I thought they were fantastic cars for the money—but you had to know someone who knew how to fix them. You had Americans working on them with American wrenches, trying to put an American thread bolt in a metric hole—and then it leaked oil. Why is *thaaat*?

People over the age of 55 hear the name Fiat and think, "Fix It Again Tony." Younger people have never heard that phrase. The younger generations tend to look to Europe and Japan for quality products. So I think enough time has passed, and people don't have those negative associations with Fiat anymore. When I was a kid, my dad called a Fiat or a Mercedes-Benz "those foreign jobs."

He'd say: "You can't get parts for that. It's a foreign job."

You need an Italian mechanic." Till the day he died, my father thought Japanese brands like Honda and Sony



were like the little bamboo umbrellas that come in your drink. To him, those countries had lost the war, and they made crummy products. Eventually, that generation moved on.

In the near future, I think we'll see boutique Fiat dealerships. If you want to buy a new Fiat 500, you'll go to a cute little store and buy the cool jacket and the hat, and even the little espresso machine. Some people say the last thing we need is a new nameplate, but we've been losing brands since 1912. Everybody laments the passing of Pontiac and Oldsmobile, but when I was a kid, it was DeSoto, then Nash, Rambler, Studebaker and Hudson. We *lost* more brands in the early '60s than we have now.

So I wish 'em luck. Competition is good. The Corvette ZR1 wouldn't be around if it hadn't been for the Viper. ("Hey, it's got 500 horsepower, that's enough, right?") The more players, the better the game. If the Red Sox played the Yankees every year, it would get pretty boring.

PM

The Fiat 500 is coming to the U.S. in 2011.



JOBSITE ELECTRONICS WITH MAXIMUM PERFORMANCE, DURABILITY AND RUN TIME



RYOBI TEK4
CORDLESS ELECTRONIC TOOLS

Dust, water, even the occasional drop, TEK4® tools are built to endure the toughest jobsites. Each tool is designed for ultimate performance and ease of use, and just one battery powers them all. A single TEK4® battery outlasts up to 6,000 AA Alkaline batteries – the equivalent of you throwing \$8,800 into your local landfill. Making it both economically and environmentally friendly.

Work. Weather. Life.™

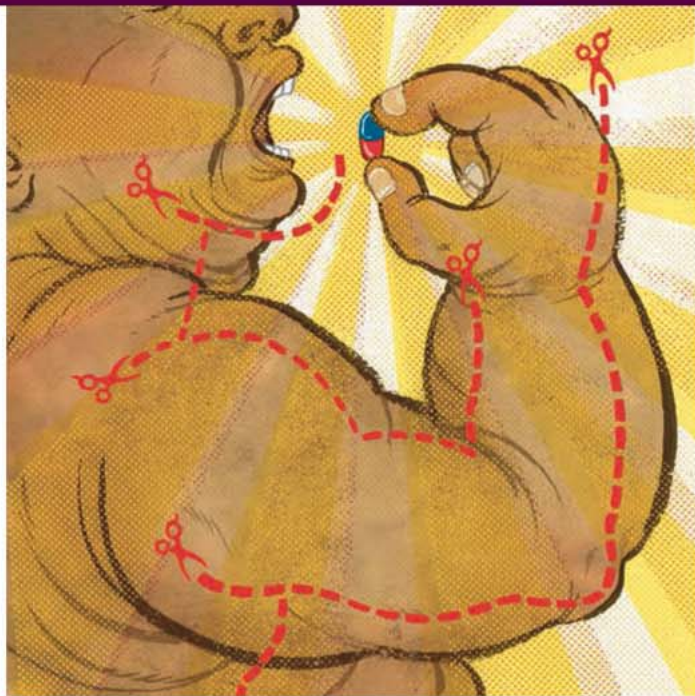


Introducing TEK4® AllPlay™, the most durable and versatile portable music player with over 72 hours of continuous MP3, WMA, WAV, and iTunes® audio play. The TEK4® AllPlay™ is impact, dust, and water resistant to make sure nothing stops the music. Power your music with the same interchangeable TEK4® battery.

*iTunes is the property of Apple. This product is not designed, manufactured, sponsored, or endorsed, by Apple. RYOBI is a registered trademark of Ryobi Limited, used under license. Blackberry not included or part of the Ryobi TEK4 product line. Blackberry is the property of Research In Motion. Ryobi TEK4 products are not designed, manufactured, sponsored, or endorsed, by Research In Motion.

More saving. More doing.™
www.homedepot.com





SCIENTISTS HAVE FOUND A NEW WAY TO REV THE BODY'S METABOLISM: ACTIVATE ITS FAT CELLS.

release energy from food calories directly as heat. This spring, multiple studies in *The New England Journal of Medicine*—including one co-authored by Cypess, now a research associate at the Joslin Diabetes Center in Boston—confirmed that not only is brown fat common in adults, it's also important to metabolism: Younger, thinner people have more detectable brown fat than their older, pudgier counterparts.

As it turns out, doctors are still discovering how fat works. Rather than just a blubbery, lifeless mass, fat is now considered to be a sophisticated and scientifically complex biological organ, as important to the body as the liver or the kidneys. Scientists believe that fat secretes hormones and signaling molecules that coordinate behavior and health. White fat also plays a significant role in the immune system: A study published in August in the journal *Immunity* concluded that fat droplets help protect the body against immune-system invaders. A 2008 study published in *Cell Metabolism* found that the fat that accumulates around the thighs and hips, called subcutaneous fat, actually lowers risk of diabetes. “We were taught that white fat was something that stores energy very efficiently, and that’s it,” Cypess says. “Fat has undergone a renaissance.”

Despite this new perspective, doctors agree that most people have a lot more white fat than they need. A whopping 34 percent of Americans over the age of 20 are obese, and much of the fat that accumulates on an obese body is visceral:

THE FUTURE OF FAT

> BY MELINDA WENNER

> ILLUSTRATION BY YUKO SHIMIZU

Five years ago this February, Aaron Cypess had an epiphany about fat. A fellow in endocrinology at Boston's Beth Israel Deaconess Medical Center, Cypess happened to be attending a lecture in which a doctor presented images of human PET scans. At one point, Cypess recalls, the doctor indicated an area corresponding to the neck and said, rather dismissively, “Oh, that’s brown fat.” Cypess was taken aback. After the lecture, he approached the doctor and told him he must have been mistaken: Everyone knows there’s no brown fat in human adults. The doctor responded, “Yeah, there is. We see it all the time.” Cypess paused. “Wait a minute,” he said. “Really?”

Brown fat has long been known to exist in infants and animals such as mice, but until recently scientists thought it disappeared before human adulthood, leaving only the white fat that’s associated with weight gain. Unlike white fat, which stores energy, chestnut-colored brown fat burns it. Brown fat cells contain a large supply of organelles called mitochondria, and an enzyme that allows them to

It surrounds vital organs and increases the risk of diabetes, as well as cancer and stroke. For these people, the discovery of brown fat, which is concentrated in the neck and chest, provides a glimmer of hope. Scientists have now begun to think about fat as a potential treatment for conditions such as obesity, rather than just a cause.

FLIPPING THE FAT SWITCH

→ **Cypess's research** has shown that, besides young, thin people, women are twice as likely as men to have significant amounts of active brown fat—perhaps because with less muscle mass, they need brown fat to stay warm. In fact, temperature seems to be an important controller of brown fat activity. A team led by Sven Enerbäck, a medical geneticist at the University of Gothenburg in Sweden, found that when subjects spent 2 hours in a cold room wearing thin clothing and intermittently soaking their feet in ice water, their brown fat burned 15 times more energy than it did at room temperature. One subject had enough brown fat to lose 8 to 9 pounds per year. Dutch researchers found active brown fat in 23 out of 24 subjects when they were cold, but not when they were warm. And research at the University of Nottingham in England revealed brown fat activity was closely associated with seasonal decreases in daylight as well.

Animal studies also suggest brown fat boosts weight loss. Last year, Stockholm University scientists found that mice that could not make brown fat gained weight 50 percent faster than mice that could. In a 2008 study, mice fed a high-fat diet and kept at room temperature ended up nearly four times heavier than mice fed the same diet and housed at 39 F. Researchers estimate that just 2 ounces of active brown fat could burn 300 to 500 calories a day. “You don’t need much to

have a profound effect on your body’s metabolism,” Cypess says.

So how do you turn brown fat on without having to soak your feet in ice water? As a postdoctoral fellow at the Harvard-affiliated Dana-Farber Cancer Institute in Boston, Patrick Seale identified a protein called PRDM-16 that is present in every brown fat cell but absent from white fat cells. When he turned off PRDM-16 activity in young brown fat cells, they changed into muscle cells. Now an assistant professor at the University of Pennsylvania School of Medicine, Seale is working on identifying genes that may turn PRDM-16 on.

Seale’s adviser at Dana-Farber, Bruce Spiegelman, is testing a therapy that involves removing white fat precursor cells from animals, inserting active PRDM-16 and then transplanting the cells back into the animals to see if they lose weight. Mitchell Lazar, director of the Institute for Diabetes, Obesity and Metabolism at the Univer-

Ultimately, what Seale and Cypess envision is a “brown fat pill”—a drug that boosts the activity of brown fat through molecular means. “I have patients who are 400 pounds,” Cypess says. “I have to find a way to help them out.” Of course, they realize such a drug won’t provide a quick fix for obesity. But brown fat could help people achieve weight loss goals by burning, say, an extra 500 calories a day.

Until a pill becomes available, there are ways for people to rev up their brown fat activity. “I don’t think you could get a lot of people to put up with [cold] therapy,” Enerbäck says, but it could help to turn down your home’s central heating and to spend some time outside in the fall and winter. Studies suggest that people who work outdoors have higher brown fat activity than average, so it’s not absurd to think that walking to work on a brisk day could boost your metabolism.

As scientists continue to study fat in a new light—as an important organ

ULTIMATELY, WHAT SEALE AND CYPESS ENVISION IS A “BROWN FAT PILL”—A DRUG THAT BOOSTS BROWN FAT ACTIVITY THROUGH MOLECULAR MEANS.

sity of Pennsylvania School of Medicine, admits that the idea seems pretty farfetched. “On the other hand, I can’t really think of any reason why it wouldn’t work,” he says.

CREATING A MAGIC PILL

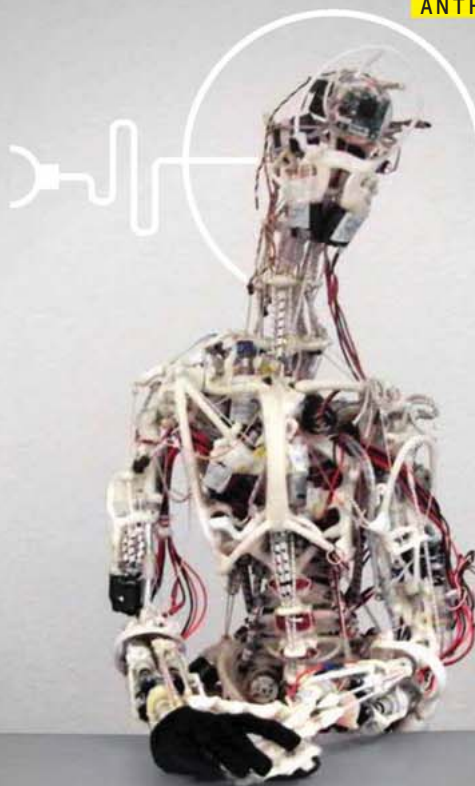
→ **Cypess and his colleagues** are focusing on different proteins, including one called BMP-7 that aids bone growth. (Bone communicates regularly with fat.) Recently, one researcher found that BMP-7 increases the production of brown fat and protects against obesity in mice. The U.S. Food and Drug Administration has already approved a BMP-7 drug for use in spinal surgery, so Cypess is testing the drug’s effects on surgical patients to see if it boosts brown fat too. “If it works, we’ve leapfrogged past several years of research,” he says.

in the body’s endocrine system—they are bound to find more opportunities. For example, a study published in July by Paul MacLean and his colleagues at the University of Colorado at Denver revealed new insight into exercise and weight loss: Physical activity reduces weight by increasing the brain’s sensitivity to appetite-suppressing hormones like leptin and insulin more so than by burning calories. According to MacLean, it may make the brain “more receptive to what the leptin and insulin are trying to say.”

Perhaps, then, it’s possible to conceive of an “exercise pill” too. Sure, it sounds ridiculous. But given the gravity of the situation, there may not be any harm in being imaginative. “We certainly need creative new ways of thinking about combating the obesity epidemic,” Enerbäck says. **PM**

10 TECH CONCEPTS You Need To Know For 2010

by ALEX HUTCHINSON



1.

ANTHROPOMIMETIC MACHINES

No matter how closely a robot resembles a human on the outside, if you crack it open, the jumble of wires is unlikely to bear much resemblance to our insides. A group of European researchers aims to bridge that gap—its robot prototype is anthropomimetic, meaning it mimics the human form. There's a skeleton made of thermo-plastic polymer, actuators that correspond to each muscle and kinteline as tendons. The goal is to create a more human-like robot that interacts with and responds to environments the way we do.

2. DIRECT CARBON FUEL CELL

Coal is dirty, and fuel cells run on hydrogen—that's the conventional wisdom. But a new generation of "direct carbon" fuel cells challenges that. Instead of relying on hard-to-produce hydrogen, these cells pull

their power from an electrochemical reaction between oxygen and pulverized coal (or some other source of carbon, like biomass). The advantage: carbon-based energy production that requires no combustion,

allowing it to operate at about twice the efficiency of a typical coal-fired power plant. California-based Direct Carbon Technology expects to have a 10-kilowatt prototype running on biomass in 2010, while Ohio-based Contained Energy hopes soon to use the tech to power a small light bulb. Eventually, the companies hope to build modular fuel cells that can be stacked in order to create new small-scale power plants or add clean capacity to existing plants.



3. METABOLOMICS

For the past five years, scientists at the University of Alberta in Edmonton have been working on the Human Metabolome Project, a database of the 8000 naturally occurring metabolites

(that is, small molecules involved in chemical reactions in the body), as well as 1450 drugs, 1900 food additives and 2900 toxins that turn up in blood and urine tests. With this information, researchers can analyze a patient's metabolomic profile, allowing them to tell from a drop of blood or urine whether somebody likes chocolate—or is likely to develop a life-threatening disease. Today, these tests require million-dollar pieces of equipment that are mostly confined to research labs. The Project's database, which was first released in 2007, is already being used in commercial applications such as drug discovery and disease diagnosis, making quick and easy tests for personalized health and medical guidance possible.



4. DNA ORIGAMI

Scientists at Caltech have been folding microscopic strands of DNA into interesting shapes for the past few years. A cool party trick for sure, until a breakthrough last summer suggested that the folded strands could be used to



5. PIEZOELECTRIC DISPLAY

Scientists have long known about naturally occurring piezoelectric materials, which have the ability to transform electrical energy into physical stress and vice versa. But by building the property into electronic displays, companies can now create screens that can change shape

or texture. This year, the technology is expected to make the leap into mainstream consumer products, offering the potential for mobile devices with screens that can harden protectively when turned off, and soften into a depressible touchscreen when turned on.



He's a tough guy.
But he cleans up
after himself.



No Residue Duct Tape.

To find out where to buy, go to ScotchToughTape.com

**BIG IDEAS ///
10 TECH CONCEPTS**

create ultrasmall computer chips. That's when the scientists teamed up with IBM researchers and showed that they could strategically position folded DNA shapes, such as triangles, along the sort of silicon wafer used in microchips. This should allow them to use pieces of the DNA strands as anchor points for tiny computer-chip components that could be built as little as 6 nanometers apart—a huge improvement over the current standard of 45 nm.


6. OSSEOINTEGRATION

The ideal prosthetic limb would behave like part of the natural body. Osseointegration allows prosthetics to fuse with a patient's living bone—it works by taking advantage of the fact that bone cells attach to titanium instead of rejecting it. The technique has already been used for small-scale dental and facial implants, and researchers are now bringing it to full-scale limb prosthetics. After a successful lower-leg implant in 2008 on a German shepherd named Cassidy, veterinary surgeons at North Carolina State University have six more leg operations on amputee dogs planned for 2010, and are considering a case involving an ocelot at the North Carolina Zoo. But the big challenge ahead is to implement the technology in human limbs.



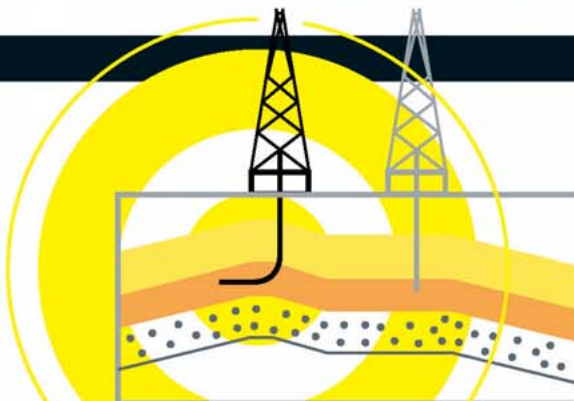
PHOTOGRAPH BY ASSOCIATED PRESS (DOG); ILLUSTRATION BY LEANDRO CASTELAO (DRILLING)


7. HORIZONTAL DRILLING

Trillions of cubic feet of natural gas in the United States lie buried within layers of shale as much as 11,000 feet deep. Much of this gas is inaccessible through ordinary wells—the dense rock makes it flow

too slowly. The answer: wells that drill vertically down to the shale bed, then make a gradual 90-degree horizontal turn through the shale deposit. It's an old idea, but higher energy prices and better technology

have suddenly made it a hit. In 2008, Chesapeake Energy deployed 14 horizontal drilling rigs in the South's massive Haynesville Shale deposits, and they expect to have 40 rigs up by the end of 2010.



8. KINETIC HYDROPOWER

Traditional hydroelectricity requires dams—massive engineering works that remake local landscapes and ecosystems. A less intrusive solution: kinetic hydropower, which uses underwater turbines to capitalize on the natural flow of rivers and tides. Since 2006, Verdant Power has been testing six underwater turbines in New York's East River to prove the technology's potential. In 2010, the company expects to receive licensing for a major build-out of 30 underwater turbines in the river, to the east of New York's Roosevelt Island, that will feed 1 megawatt of power into the grid.



Other projects around the world are expected to complete testing soon and begin full-scale operation, including three installations that tap some of the highest tidal ranges in the world, in Canada's Bay of Fundy.



9. NANOPYARN

Carbon nanotubes have been touted as the next big thing ever since their discovery in 1991. The appeal lies in their strength (they are up to 100 times stronger than steel) and their ability to conduct both heat and electricity. But, until now, they've been too difficult to manufacture in useful quantities. That's finally changing: New Hampshire-based Nanocomp Technologies is weaving nanotubes into lengths of yarn that can be built into commercial applications. The company recently delivered more than 6 miles of nanoyarn to a major aerospace client, and successful bullet-stopping tests last spring have the Pentagon excited about the prospect of next-gen body armor that's both lighter and thinner than Kevlar.

10. ULTRACAPACITORS

The biggest challenge for electric cars is energy storage: Batteries are better than ever, but they are still expensive, slow to charge and have fairly limited life spans. The solution may be ultracapacitors, which hold less energy than batteries (at least as the technology currently stands) but have virtually none of their drawbacks. That means longer life spans, no messy chemical reactions, no issues with battery memory and far greater durability. Researchers have been trying to perfect automotive ultracapacitors for several years (MIT is working on nanotube-based ultracaps, while Argonne National Laboratory is exploring battery-ultracap hybrids), but the big move could come from the secretive Texas-based company EESor, which announced in April that its barium-titanate design had passed a crucial test. Though the company's claims have aroused skepticism, EESor's automotive partner, ZENN Motors, is hyping the release of an ultracapacitor-powered car in 2010.

PM

He's a tough guy.
But you can see
right through him.



Transparent Duct Tape.

To find out where to buy, go to ScotchToughTape.com

Amish mantle and miracle invention help home heat bills hit rock bottom

Miracle heaters being given away free with orders for real Amish fireplace mantles to announce the invention that helps slash heat bills, but Amish craftsmen under strain of Christmas rush force household limit of 2

Save money: only uses about 9¢ electric an hour; so turn down your thermostat and never be cold again

By MARK WOODS
Universal Media Syndicate

(UMS) Everyone hates high heat bills. But we're all sick and tired of simply turning down the thermostat and then being cold.

Well now, the popular HEAT SURGE® miracle heaters are actually being given away free to the general public for the next 7 days starting at precisely 8:00 a.m. today.

The only thing readers have to do is call the National Distribution Hotline before the 7-day deadline with their order for the hand-made Amish Fireplace Mantle. Everyone who does is instantly being awarded the miracle heater absolutely free.

This is all happening to announce the HEAT SURGE Roll-n-Glow® Fireplace which actually rolls from room-to-room so you can turn down your thermostat and take the heat with you anywhere. That way, everyone who gets them first can immediately start saving on their heat bills.

Just in time for winter weather, portable Amish encased fireplaces are being delivered directly to the doors of all those who beat the deadline.

These remarkable fireplaces are being called a miracle because they have what's being called the *Fireless Flame*™ patented technology that gives you the peaceful flicker of a real fire but without any flames, fumes, smells, ashes or mess. Everyone is getting them because they require no chimney and no vent. You



■ **GENUINE AMISH MANTLES MADE IN THE USA:** Everyone wants to save money on heat bills this winter, so entire Amish communities are working from the crack of dawn to finish. These fine real wood Amish made fireplace mantles are built to last forever. The oak mantle is a real steal at just two hundred ninety-eight dollars because all those who beat the order deadline by calling the National Hotline at 1-866-815-7004 to order the fireplace mantles are actually getting the imported hi-tech *Fireless Flame* HEAT SURGE miracle heaters for free.

just plug them in.

The *Fireless Flame* looks so real it amazes everybody because it has no real fire. So what's the catch? Well, soft spoken Amish craftsmen who take their time hand



■ **JUST ANNOUNCED:** The Heat Surge miracle fireplace has earned the prestigious Good Housekeeping Seal. The product has earned the Seal after evaluation by the Good Housekeeping Research Institute.

building the mantles have a process that forces a strict household limit of 2 to keep up with orders.

"We can barely keep up ever since we started giving heaters away free. With winter just around the corner, everyone's trying to get them. Amish craftsmen are working their fingers to the bone to be sure everyone gets their delivery in time for Christmas," confirms Frederick Miller, National Shipping Director.

"These portable Roll-n-Glow Fireplaces are the latest home decorating sensation. They actually give you a beautifully redecorated room while they quickly heat from wall to wall. It's the best way to dress up every room, stay really warm and slash your

heat bills all at the same time," says Josette Holland, Home Makeover Expert.

And here's the best part. Readers who beat the 7-day order deadline are getting their imported hi-tech miracle heaters free when encased in the Amish built real wood fireplace mantles. The mantles are being handmade in the USA right in the heart of Amish country where they are beautifully hand-rubbed, stained and varnished.

You just can't find custom made Amish mantles like this in the national chain stores. That makes the oak mantle a real steal for just two hundred ninety-eight dollars since the entire cost of the miracle heater is free.

This free giveaway is the best way to slash heating

HEAT SURGE™ Fireless Flame™

How It Works: The HEAT SURGE miracle heater is a work of engineering genius from the China coast so advanced, you simply plug it into any standard outlet. It uses only about 9¢ of electric an hour on the standard setting. Yet, it produces up to an amazing 5,119 BTU's on the high setting. So watch out, a powerful on board hi-tech heat turbine silently forces hot air out into the room from the vent so you feel the bone soothing heat instantly. It even has certification of Underwriters Laboratories coveted UL listing. It also comes with a limited full year replacement or money back warranty less shipping plus a 30-Day Satisfaction Guarantee. OH and FL resident transactions require the remittance of applicable sales tax. Sorry no shipments to MA residents.



LISTED: E322174



bills and stay warm this fall and winter. The HEAT SURGE Roll-n-Glow Fire-plate gives you zone heating and all the beauty and warmth of a built-in fireplace but rolls from room-to-room so it can also save you a ton of money on heating bills.

Even people in California and Florida are flocking to get them so they may never have to turn on their furnace all winter. And since it uses

only about 9 cents of electric an hour on the standard setting, the potential savings are absolutely incredible.

"We are making sure no one gets left out, but you better hurry because entire communities of Amish craftsmen are straining to keep up with demands. For now, we are staying out of the large national retail stores in order to let readers have two per household just as long as they call before the deadline," con-

firms Miller.

It's a really smart decision to get two right now because for only the next 7 days you get both miracle heaters free. That's like putting five hundred bucks right in your pocket and you can save even more money on your monthly heating bills.

"Everyone's calling to get one but those who are getting their Christmas shopping done are surprising the whole family by getting

two. So when lines are busy keep trying or log onto amishfireplaces.com. We promise to get to every call. Then we can have a delivery truck out to your door right away with your beautiful Heat Surge Roll-n-Glow Fireplace," Miller said.

"You'll instantly feel bone soothing heat in any room. You will never have to be cold again," he said. ■

On the worldwide web:
www.amishfireplaces.com



■ **EASILY ROLLS ANYWHERE:** This is the portable Roll-n-Glow® Fireplace that easily rolls from bedroom to living room to keep you warm. No vents, no chimney and no tools. Just plug it in.



■ **SAVES ON BILLS:** Everyone can get low bills and stay warm and cozy. The Roll-n-Glow Fireplace saves a ton of money and makes your front room look like a million bucks.



■ **SAFE FLAME:** The Fireless Flame looks so real it fools everyone but there is no real fire. That makes the flame window safe to the touch under the watchful eye of a parent. It's where the kids will play and the cat and dog will sleep.



■ **FREE:** Get this \$249 miracle heater free. It is being given away free to all who beat the 7-day order deadline for your choice of the oak or cherry finish Amish Mantles. The free heater comes already encased.

How to get 2 free heaters

The National Toll Free Hotlines are now open. All those who beat the 7-day order deadline to cover the cost of the Amish made Fire-place Mantle and shipping get the HEAT SURGE miracle heater free.

A strict limit of 2 per household has been imposed. Since some home woodworkers want to build their own mantle piece, they are letting people get the imported miracle heater alone for just \$249. Or, with the Amish made mantle you get the miracle heater free.

Use the map below to locate the weather zone you live in and call the Hotline number for your zone.



Claim Code: FP10664

EVERYONE LIVING IN THE

Frigid Zone: 1

START CALLING AT

8:00 A.M. TODAY

1-866-815-7004

EVERYONE LIVING IN THE

Cold Zone: 2

START CALLING AT

8:30 A.M. TODAY

1-866-815-7110

EVERYONE LIVING IN THE

Frost Zone: 3

START CALLING AT

9:00 A.M. TODAY

1-866-815-7112

FOR HEAT SURGE, LLC 8000 FREEDOM AVE., N. CANTON OH 44720

©2009 HEAT SURGE, LLC P4721A 09574R-1



■ **ON THEIR WAY:** Christmas orders have turned country roads into pipelines to the big city delivery system. Everybody wants a fireplace that comes fully assembled with a handmade Amish mantle in oak or cherry finish and gets delivered by truck right to your door. All you do is plug it in.

OCEAN ROWER

> BY CHRISTOPHER MAAG
> ILLUSTRATION BY SINELAB

Katie Spotz always considered herself a lousy athlete—which makes the 22-year-old's quest to become the youngest person ever to row solo across the Atlantic Ocean seem a little odd.

"Growing up, I was a benchwarmer," says Spotz, who competed on her high school swim, tennis and track teams in Mentor, Ohio. But after running a marathon at 18, she discovered that in

long-distance sports, mental toughness matters more than physical strength. Spotz has cycled 3300 miles across the U.S. and was the first person to swim all 352 miles of the Allegheny River. When she learned about ocean rowing, she thought it would be the perfect way to raise awareness about the 1.1 billion people who lack access to safe drinking water. Donations made at Spotz's website, rowforwater.com, will help the Blue Planet Run Foundation build clean-water projects around the world. Now all she has to do is row—Spotz starts her journey in late December. "Every endurance event has that moment when everything falls apart," she says. "You have to be 100 percent focused and aware. That's what I like about adventures like this."

A. Shape

Boat design requires finding the perfect compromise, says Phil Morrison, who drew the plans for Spotz's 19-foot vessel. "The boat is relatively long and slender, making it easier to row," Morrison says. "But if you make it too slender, it becomes unstable." Unlike traditional rowboats, the craft has two watertight cabins—one for sleeping, the other for gear and food—that shield Spotz from wind as she rows.



B. Food and Water

A 100-pound tank of salt water supplies the 6 liters of drinking water Spotz needs every day. A hose connects the tank—which can be replenished by opening a valve in the footwell—to a desalination machine that can produce 6 gallons of fresh water an hour. But because the machine uses a lot of electricity and is prone to failure, Spotz will run it for only 20 minutes every other day. She'll eat 5000 calories of dehydrated food, energy bars and trail mix daily.



● D. Route

Spotz will launch from Dakar, Senegal, in late December and travel west with the dominant currents. It will take her 70 to 100 days to row 2500 miles across the Atlantic. She'll aim for Cayenne, French Guiana. But the boat's weight relative to Spotz's strength will make it difficult to counteract wind and northwest currents that could push her toward cliffs or rocks. Currents may also force her to row another 500 miles to Georgetown, Guyana. "The toughest part of the trip will be the arrival," Spotz says.

● E. Power and Communication

The boat's instruments are powered by electricity from two solar panels—an 85-watt and a 65-watt—mounted atop the cabins. The panels charge two 12-volt batteries, which connect to the VHF radio, GPS and navigation lights. An Automatic Identification System sends the coordinates of Spotz's boat to surrounding ships and warns her when other boats get too close. Spotz will bring an iPod for music and a laptop to track weather and blog. She has a satellite phone for emergencies, but will also use it to update her Twitter account.

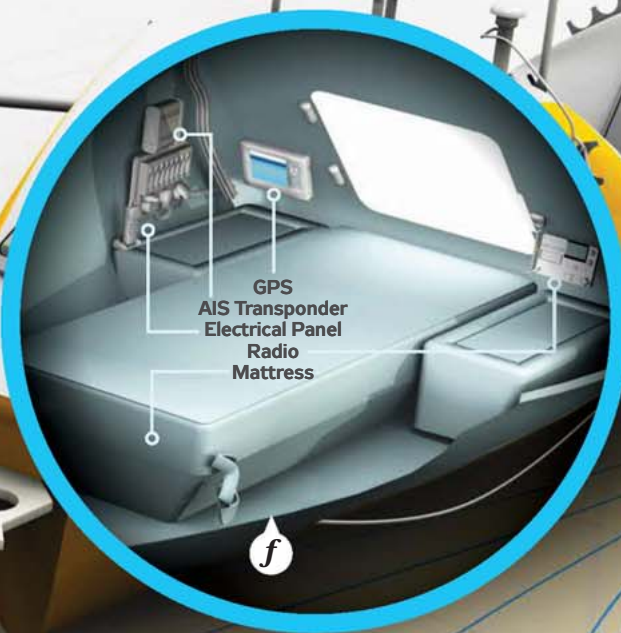
● C. Mobility

Sails are prohibited in ocean rowing, so the boat's only power comes from Spotz pulling

against carbon-fiber oars. Her seat slides forward and back on tracks in the center of the cockpit, which increases the oars' angle of attack as they enter the water—making each stroke longer and more efficient. Spotz faces the stern and straps her feet into shoes bolted to a board in the footwell. Her right shoe is connected to a cable that runs through the rear cabin and hooks into the tiller, which is screwed to the rudder, so she can steer as she rows. If strong headwinds blow her backward, Spotz can attach a parachute anchor to the stern that inflates underwater and slows reverse travel.

● F. Ballast and Buoyancy

If the boat becomes submerged in high seas, the cabins trap enough air to lift the vessel to the surface. But without ballast weighing down the bottom, the boat would list to its side and could trap Spotz underwater. "You have to give the cabin enough volume that the boat is unstable when it's in that position," Morrison says. "You shouldn't need a lot of ballast, which is just gratuitous weight." So the food, batteries and desalination unit, secured as low as possible, become the ballast—and so does Spotz, who will strap herself to the cabin floor in high seas. The combined weight will flip the boat right side up. A central tank can store 100 pounds of seawater, which serves as additional ballast, but it's not really necessary. "This boat has enough ballast to right itself when the tank is empty," Morrison says.




View from the brink

James Cameron is a moviemaker with a passion for cutting-edge technology and risky projects. Will his movie Avatar be a breakthrough or a



breaking point?



The 280,000-square-foot studio in Playa Vista, Calif., has a curious history as a launching pad for big, risky ideas. In the 1940s, Howard Hughes used the huge wooden airplane hangar to construct the massive plywood H-4 Hercules seaplane—famously known as the Spruce Goose. Two years ago, movie director James Cameron was in the Playa Vista studio at a crucial stage in his own big, risky project. He was viewing early footage from *Avatar*, the sci-fi epic he had been dreaming about since his early 20s. Cameron's studio partner, Twentieth Century Fox, had already committed to a budget of \$200 million (the final cost is reportedly closer to \$300 million) on what promised to be the most technologically advanced work of cinema ever undertaken. But as Cameron looked into his computer monitor, he knew something had gone terribly wrong.

The film—although “film” seems to be an anachronistic term for such a digitally intense production—takes place on a moon called Pandora, which circles a distant planet. Jake Sully, a former Marine paralyzed from the waist down during battle on Earth, has traveled to this

By Anne Thompson

DIRECTOR JAMES CAMERON HOLDING
AN ANTIQUE STEREOSCOPE.
PHOTOGRAPHED BY
JOE PUGLIESE,
SEPT. 19, 2009,
AT FOX STUDIOS IN
LOS ANGELES, CALIF.

lush, green world teeming with exotic, bioluminescent life to take part in the military's avatar program. The human settlers are interested in mining Pandora's resources but can't breathe its toxic atmosphere, so to help explore the moon and meet with the native Na'vi who live there, Sully has his consciousness linked with a genetically engineered 9-foot-tall human-alien hybrid.

Cameron wrote his first treatment for the movie in 1995 with the intention of pushing the boundaries of what was possible with cinematic digital effects. In his view, making *Avatar* would require blending live-action sequences and digitally captured performances in a three-dimensional, computer-generated world. Part action-adventure, part interstellar love story, the project was so ambitious that it took 10 more years before Cameron felt cinema technology had advanced to the point where *Avatar* was even possible.

The scene on Cameron's screen at Playa Vista—an important turning point in the movie's plot—showed Na'vi princess Neytiri, played by Zoë Saldana, as she first encounters Sully's avatar in the jungles of Pandora. Everything in the forest is luminous. Glowing sprites float through Pandora's atmosphere, landing on Sully as Neytiri determines if he can be trusted. Playing Sully is Sam Worthington, an Australian actor whom Cameron had plucked from obscurity to play the movie's hero. Cameron was staring directly into Worthington's face—or, rather, he was looking into the face of a digitally rendered Worthington as a creature with blue skin and large yellow eyes—but he might as well have been staring into a Kabuki mask.

The onscreen rendering of Worthington was supposed to be a sort of digital sleight of hand—a human character inhabiting an alien body so that he could blend into an alien world, played by a human actor inhabiting a digital body in a digital world. To make the whole thing work, Worthington's performance, those subtle expressions that sell a character to the audience, had to come through the face of his avatar. But after millions



FOR THE MOVIE *AVATAR*, ACTOR SAM WORTHINGTON WAS TRANSFORMED INTO A HUMAN-ALIEN HYBRID THROUGH PERFORMANCE-CAPTURE TECHNOLOGY.

of dollars of research and development, the avatar's face was not only lifeless, it was downright creepy. It "scared the crap out of me," Cameron recalls. "Horrible! It was dead, it was awful, it wasn't Sam. God, I thought. We've done everything right and this is what it looks like?"

The reaction Cameron was feeling has a name. It's called the uncanny valley, and it's a problem for roboticists and animators alike. Audiences are especially sensitive to renderings of the human face, and the closer a digital creation gets to a photorealistic human, the higher expectations get. If you map human movements and expression to cute furry creatures that dance and sing like people, then audiences willingly suspend disbelief and go along with it. (Think of the penguins in *Happy Feet*.) But if you try to give a digital character a humanoid face, anything short of perfection can be uncanny—thus the term. Sometimes audience unease is to a character's advantage; in *The Lord of the Rings* the creature Gollum was supposed to be unsettling. But Cameron was

Cameron's Greatest FX Hits

1980



Battle Beyond the Stars

EFFECT: Spaceship backdrop

Producer Roger Corman wanted his actors in spaceships, but building sets was too expensive. So Cameron—who started as the film's model builder and then became its art director—photo-collaged matte shots and projected them onto a backdrop screen, then filmed the actors in front of it. The front-projection system is still in use today.

looking for empathy, and in the first footage, that's not what he got.

Why is the computer-generated face of a blue, cat-eyed human-alien hybrid so important? Well, for one thing, lots of money is riding on it. But so, to an extent, is James Cameron's stature as an unstoppable force in Hollywood. Cameron has built up enormous fame and power based on his reputation as a technical innovator—pushing the science and technology of modelmaking, digital animation and camera engineering. But Cameron is perhaps even more famous as the industry's biggest risk-taker, which might have made him a lot of enemies if his risks hadn't been so spectacularly rewarded in the past. In 1997, the film *Titanic* taught Hollywood a power-

ful lesson in Cameronomics: The director's unquenchable thirst for authenticity and technological perfection required deep-sea exploratory filming, expensive scale models and pioneering computer graphics that ballooned the film's budget to \$200 million. This upped the ante for everyone involved and frightened the heck out of the studio bean counters, but the bet paid off—*Titanic* went on to make \$1.8 billion and win 11 Academy Awards.

A unique hybrid of scientist, explorer, inventor and artist, Cameron has made testing the limits of what is possible part of his standard operating procedure. He dreams almost impossibly big, and then invents ways to bring those dreams into reality. The technology of moviemaking

is a personal mission to him, inextricably linked with the art. Each new film is an opportunity to advance the science of cinema, and if *Avatar* succeeds, it will change the way movies are captured, edited and even acted.

Filmmakers, especially those with a technical bent, admire Cameron for "his willingness to incorporate new technologies in his films without waiting for them to be perfected," says Bruce Davis, the executive director of the Academy of Motion Picture Arts and Sciences. It adds to the risky nature of Cameron's projects, but his storytelling has reaped enormous benefits. There's a term in Hollywood for Cameron's style of directing, Davis says: "They call this 'building the parachute on the way down.'"

1984



The Terminator

EFFECT: Robot self-surgery

After his directorial debut (1981's *Piranha Part Two*), Cameron was under pressure to make his mark. He and FX whiz Stan Winston designed a prosthetic to make it appear as though the Terminator was taking apart his own robotic arm—while allowing actor Arnold Schwarzenegger to wiggle his fingers. These days, the effect would be computer-generated.

1989



The Abyss

EFFECT: Water tentacle

Innovations in *The Abyss* included illuminated water helmets and self-propelled camera platforms. But Cameron's biggest advance was in computer graphics. A digitally rendered water tentacle was cinema's first soft-surface character with a human face. The creature was based on scans of actors' faces used to create a 3D polygonal mesh surface.

1991



Terminator 2: Judgment Day

EFFECT: The T-1000 morphs into an LAPD patrolman

Cameron resurrected the "morph" technique used in *The Abyss* to turn actor Robert Patrick into the liquid-metal T-1000. This was the first time dialogue was synced with a computer-generated human face and full-body motion. It would take 18 years for visual-effects artists to create a photo-real CG human.

1997

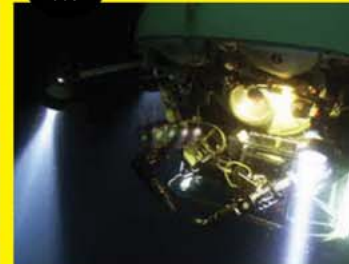


Titanic

EFFECT: A virtual crowd on the ship's deck

Cameron and effects house Digital Domain used motion capture to create the iconic scenes of many passengers walking on the *Titanic*'s decks. A few actors' movements were captured, then Cameron replicated them. Director Peter Jackson and his effects house, Weta Digital, later refined the technology to populate huge battle scenes in *The Lord of the Rings*.

2003



Ghosts of the Abyss

EFFECT: 3D dives to the *Titanic* wreckage

To shoot a series of scientific documentaries, Cameron and inventor Vince Pace developed a stereoscopic camera—really, two cameras aligned to mimic human depth perception. The rig used in *Ghosts* was a precursor to the Fusion 3D cameras Cameron relied on for *Avatar*'s live-action sequences.

Directing a Virtual World

STAGE RENDER BY AXEL DE ROY
DIAGRAMS BY LOCOGRAFIX

1 The Volume

Most of James Cameron's space epic, *Avatar*, was shot on a performance-capture stage, known as the volume, in Playa Vista, Calif. The volume was rimmed by 120 stationary video cameras, which could record the movements of all actors at once in 3D, with submillimeter precision. Data from the cameras was streamed into Autodesk software, which translates actors' movements into digital characters in real time within a low-resolution computer-generated environment. So riding a fake banshee mockup onstage instantly translated to CG footage. Multiple cameramen were used on set for reference video, but because the volume essentially captures performances from every angle at once, Cameron could digitally render whatever angles and shots he wanted after the performance, adjusting the camera movements while viewing playback.

3 On-Set Playback

To shoot a scene within a totally CG world, Cameron had virtual production supervisor Glenn Derry rig up augmented-reality cameras. Cameron could watch from the sidelines as his actors' performances were instantly mapped to their CG characters and displayed via an on-set screen. Or he could use a portable, motion-tracking virtual camera to walk through the volume and view the CG environment of the movie on its LCD screen.

2 Digital Closeup

Like many actors in *Avatar*, Zoë Saldana plays a fully computer-generated character, Na'vi princess Neytiri. To map her movements to her digital doppelgänger, Saldana wore a motion-capture bodysuit with reference markers and stripes. She also wore a head rig designed by Cameron that aimed a small video camera at her face. That camera tracked green ink dots, painted on Saldana's face, throughout the scene, giving Cameron closeup-level detail of changes in expression to map to Neytiri's CG face.



4 Final Render

To transition from the CG produced on set to the photorealistic world of the finished movie, Cameron sent his rough footage to Weta Digital in New Zealand. There, special-effects programmers used a facial solve program and facial action coding to translate the actors' every minute muscle movement—blinks, twitches, frowns—to believable expressions on the faces of Pandora's aliens.

But repeatedly pulling off these feats of derring-do requires both the drive of an ambitious egomaniac and an engineer's plodding patience. "You have to eat pressure for breakfast if you are going to do this job," Cameron says. "On the one hand, pressure is a good thing. It makes you think about what you're doing, your audience. You're not making a personal statement, like a novel. But you can't make a movie for everybody—that's the kiss of death. You have to make it for yourself."

Gonzo Effects

Cameron's dual-sided personality

has roots in his upbringing—the brainy sci-fi geek from Chippewa, Ontario, was raised by a painter mother and an engineer father. "It was always a parallel push between art and technology," he says. "My approach to filmmaking was always very technical. I started off imagining not that I would be a director, but a special-effects practitioner."

Unable to afford to go to film school in Los Angeles, Cameron supported himself as a truck driver and studied visual effects on weekends at the University of Southern California library, photocopying dissertations on optical printing and the sensitometry of film stocks. "This is not bull," he says. "I gave myself a great course on film FX for the cost of the copying."

Cameron eventually landed a job on the effects crew of Roger Corman's low-budget 1980 film *Battle Beyond the Stars*, but he didn't tell anyone that he was an autodidact with no practical experience. When he was exposed to the reality of film production, it was very different from what he had imagined, he recalls: "It was totally gonzo problem solving. What do you do when Plans A, B and C have all crashed

and burned by 9 am? That was my start. It wasn't as a creative filmmaker—it was as a tech dude."

Over the years, Cameron's budgets have increased to become the biggest in the business, and digital technology has changed the realm of the possible in Hollywood, but Cameron is still very much the gonzo engineer. He helped found the special-effects company Digital Domain in the early 1990s, and he surrounds himself with Hollywood inventors such as Vince Pace, who developed special underwater lighting for Cameron's 1989 undersea sci-fi thriller, *The Abyss*. Pace also worked with Cameron on *Ghosts of the Abyss*, a 2003 undersea 3D documentary that explored the wreck of the *Titanic*. For that movie, Pace and Cameron designed a unique hi-def 3D camera system that fused two Sony HDC-F950 HD cameras 2½ inches apart to mimic the stereoscopic separation of human eyes. The Fusion Camera System has since been used for 3D movies such as *Journey to the Center of the Earth* and the upcoming *Tron Legacy*, and at sporting events such as the 2007 NBA finals.

The 3D experience is at the heart of *Avatar*. (In fact, some suspect that Cameron cannily delayed the movie's release to wait for more theaters to install 3D screens—there will be more than 3000 for the launch.) Stereoscopic movie-making has historically been the novelty act of cinema. But Cameron sees 3D as a subtler experience. To film the live-action sequences of *Avatar*, he used a modified version of the Fusion camera. The new 3D camera creates an augmented-reality view for Cameron as he shoots, sensing its position on a motion-capture stage, then integrating the live actors into CG environments on the viewfinder. "It's a unique way of shooting stereo movies," says visual-effects supervisor Stephen Rosenbaum. "Cameron uses it to look into the environment; it's not about beating people over the head with visual spectacle." This immersive 3D brings a heightened believability to *Avatar*'s live-action sequences—gradually bringing viewers

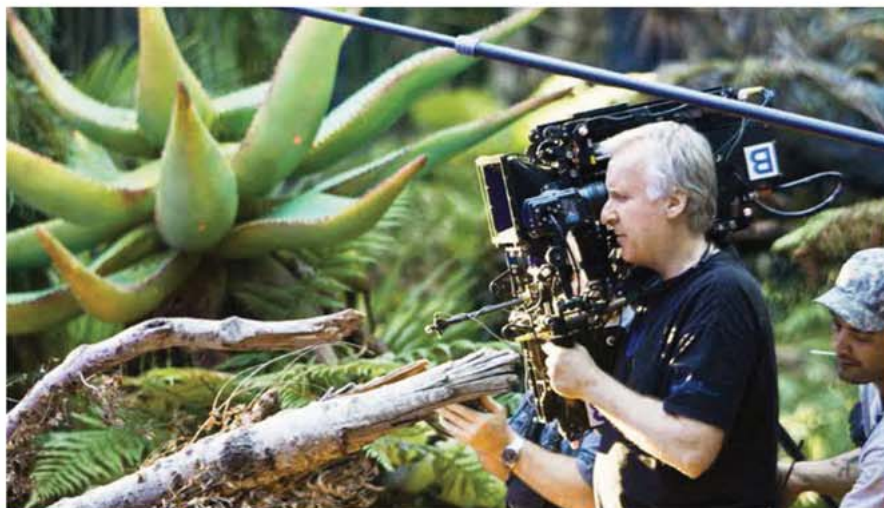


deeper into the exotic world of Pandora. In an early scene, Sully looks out the window as he flies over the giant trees and waterfalls of the jungle moon, and the depth afforded by the 3D perspective gives the planet mass and scale, making it as dizzyingly real for viewers as it is for him.

Shooting the Virtual World

Yet live-action 3D was hardly the biggest technical challenge. Only about 25 percent of the movie was created using traditional live performances on sets. The rest takes place in an entirely computer-generated world—combining performance capture with virtual environments that have never before been realized on film. Conjuring up this exotic world allowed Cameron to engage in “big-time design,” he says, with six-legged hammerhead thanators, armored direhorses, pterodactyl-like banshees, hundreds of trees and plants, floating mountains and incredible landscapes, all created from scratch. He drew upon his experience with deep-sea biology and plant life for inspiration. Sigourney Weaver, who plays botanist Grace Augustine, calls it “the most ambitious movie I’ve ever been in. Every single plant and creature has come out of this crazy person’s head. This is what Cameron’s inner 14-year-old wanted to see.”

To bring his actors into this world, Cameron collaborated with Weta Digital, an effects house founded by *The Lord of the Rings* director Peter Jackson. Weta has created some of the most groundbreaking characters in recent years, using human performances to animate digital creatures such as Gollum in the *Rings* series and the great ape in Jackson’s 2005 version of *King Kong*. By now, the process of basic motion capture is well-established. Actors are dressed in “mocap” suits studded with reflective reference markers and stripes, then cameras capture the basic movements of a performance,



EVER THE HANDS-ON DIRECTOR, JAMES CAMERON HELPED DESIGN THE FUSION 3D CAMERA THAT HE USED TO SHOOT LIVE-ACTION SEQUENCES IN THE MOVIE AVATAR.

which are later mapped to digital characters in a computer.

For actors, the process of performing within an imaginary world, squeezed into a leotard while pretending to inhabit an alien body, is a challenge. Motion-capture technology is capable of recording a 360-degree view of performances, so actors must play scenes with no idea where the “camera” will eventually be. Weaver found the experience liberating. “It’s simpler,” she says. “You just act. There’s no hair or makeup, nothing. It’s just you and the material. You forget everything but the story you’re telling.”

Directing within a virtual set is more difficult. Most directors choose their angles and shots on a computer screen in postproduction. But by then, most of the immediacy of the performance is lost. Cameron wanted to be able to see his actors moving within the virtual environments while still on the motion-capture stage (called the volume). So

he challenged his virtual-production supervisor Glenn Derry to come up with a virtual camera that could show him a low-resolution view of Pandora as he shot the performances.

The resulting swing camera (so called because its screen could swing to any angle to give Cameron greater freedom of movement) is another of *Avatar*’s breakthrough technologies. The swing camera has no lens at all, only an LCD screen and markers that record its position and orientation within the volume relative to the actors. That position information is then run through an effects switcher, which feeds back low-resolution CG versions of both the actors and the environment of Pandora to the swing cam’s screen in real time.

This virtual camera allowed Cameron to shoot a scene simply by moving through the volume. Cameron could pick up the camera and shoot his actors photographically, as the performance



Music that lives here.

Comes to life here.

Wirelessly.



NEW

Introducing the new Bose® Wave® music system – SoundLink™.
Now it's easy to enjoy your computer music anywhere in your home.

Enjoy premium Bose sound for all your computer music – Internet radio, iTunes and more. With the new Wave® music system – SoundLink™, it's quick, convenient and easy. There's no software to load. No wires to run from your computer to the system. Your computer can be in a completely different room. And the sound is that of the acclaimed Bose Wave® music system. Winner of the "Best of the Best" at the international Red Dot awards, and described by Jonathan Takiff of the *Philadelphia Daily News* as "an extraordinary performer."

Complete and simple to use.

Just plug the SoundLink™ USB key into your computer. In seconds, you're enjoying

your computer music with lifelike Bose sound. Or use the Wave® system's CD player and FM/AM tuner to play your other favorites. There's a clock, an alarm and many other features. From a small and easy-to-use system, you enjoy performance rivaling large, complicated stereos costing much more.

Try it risk free for 30 days.

Hear it in your home for 30 days. And call to ask about making **12 easy payments**, with no interest charges from Bose.* Use the risk-free trial to discover how easy it can be to enjoy all your music – including your computer music. Wirelessly. With the performance quality of Bose, the most respected name in sound.



Just plug the Wave® SoundLink™ key into a USB slot and enjoy.

**FREE shipping
with your order.**

To order or learn more, visit Bose.com/WaveSL
or call 1-800-905-1488, ext. 4218.

BOSE®
Better sound through research®

*Bose payment plan available on orders of \$299-\$1500 paid by major credit card. Separate financing offers may be available for select products. See website for details. Down payment is 1/12 the product price plus applicable tax and shipping charges, charged when your order is shipped. Then, your credit card will be billed for 11 equal monthly installments beginning approximately one month from the date your order is shipped, with 0% APR and no interest charges from Bose. Credit card rules and interest may apply. U.S. residents only. Limit one active financing program per customer. ©2009 Bose Corporation. Patent rights issued and/or pending. The distinctive design of the Wave® music system is a registered trademark of Bose Corporation. Financing and free shipping offers not to be combined with other offers or applied to previous purchases, and subject to change without notice. Risk free refers to 30-day trial only and does not include return shipping. Delivery is subject to product availability. iTunes is a trademark of Apple Inc. All other marks are property of Bose Corporation. Quotes reprinted with permission.

occurred, or he could reshoot any scene by walking through the empty soundstage with the device after the actors were gone, capturing different camera angles as the scene replayed.

But all of this technology can lead right back into the uncanny valley, because capturing an actor's movements is only a small step toward creating a believable digital character. Without the subtle expressions of the face, Cameron might as well be playing with marionettes. Getting this crucial element right required him to push Weta's technology far beyond anything the company had done before.

In fact, Cameron doesn't even like the term "motion capture" for the

process used on *Avatar*. He prefers to call it "performance capture." This may seem like semantics, but to Cameron, the subtle facial expressions that define an actor's performance had been lost for many of the digital characters that have come before. In those films, the process of motion capture served only as a starting point for animators, who would finish the job with digital brush strokes. "Gollum's face was entirely animated by hand," says Weta Digital effects master Joe Letteri. "*King Kong* was a third or so straight performance capture. It was never automatic." This time, Cameron wanted to keep the embellishment by animators to a minimum and let the

actors drive their own performances.

In order to pull more data from the actors' faces, Cameron reworked an old idea he had sketched on a napkin back in 1995: fasten a tiny camera to the front of a helmet to track every facial movement, from darting eyes and twitching noses to furrowing eyebrows and the tricky interaction of jaw, lips, teeth and tongue. "I knew I could not fail if I had a 100 percent closeup of the actor 100 percent of the time that traveled with them wherever they went," he says. "That really makes a closeup come alive."

The information from the cameras produced a digital framework, or rig, of an actor's face. The rig was then given a set of rules that applied the muscle movements of each actor's face to that of the avatar or the Na'vi that he or she was playing. To make a CG character express the same emotion as a human actor, the rig had to translate every arch of a human eyebrow directly to the digital character's face.

But it turns out there is no magic formula that can supplant hard work and lots of trial and error. After Cameron complained about the uncanny-valley effect, Weta spent another year perfecting the rig on Worthington's avatar by tweaking the algorithms that guided its movements and expressions until he came alive enough to meet Cameron's sky-high standards. "It was torturous," Letteri admits. But when Weta was finished, you could pour the motion-capture data into the rig and it would come out the other side right.

With all the attention focused on *Avatar*, anything short of perfection may not be good enough. Cameron is asking moviegoers to believe in a deep new universe of his own design and to buy the concept that 9-foot-tall blue aliens can communicate human emotions. If Cameron is wrong, then *Avatar* may be remembered as the moment when the battle for the uncanny valley was lost. If he is right, the technology will disappear behind the story line, and audiences will lose themselves in *Avatar*'s world.

PM

3D Comes Home



Stereoscopic movies make more money per theater than their 2D counterparts, but according to the 3D@Home Consortium, Hollywood studios generate as much as 50 percent of revenue from DVD sales. So the next big push for stereoscopic content is the home theater. But is it worth the upgrade? Here's what you need to know. *BY ERIN MCCARTHY*

What equipment will I need to play 3D?

Some TVs, such as DLP rear-projection sets, can already play 3D content, but current LCDs and plasmas can't, so most people will have to spring for a new set—Panasonic has announced stereoscopic plasmas for 2010. New 3D Blu-ray players are also coming this year, but some current machines, such as the PlayStation 3, will need only a simple firmware upgrade. Also required: shutter glasses, such as the Nvidia 3D Vision Kit (\$199; above).



What about content?

Right now, PC games are the only widely available stereoscopic content, but 3D@Home's Chris Chinnock expects approximately 35 movies to be released on the upcoming Blu-ray 3D format within the next year, and approximately 130 titles in the next two years—pricing for the new discs is still unknown. Stereoscopic video games for PS3 (left), Xbox and Wii are also coming this year, and 3D movies will eventually be downloadable to PCs and TVs via services such as Roxio CinemaNow.

HOT. FAST. EASY.

Introducing the compact, low-profile

QUICKFIRE TORCH

Easy access to tight spots
30% faster solder time*
Quick start ignition



* Than the Bernzomatic TS4000

Check it out today at your local hardware retailer.


BERNZOMATIC®

bernzomatic.com/quickfire

© 2009 BERNZOMATIC. ALL RIGHTS RESERVED.





by Michael Finkel
photographs by Greg Von Doersten

THE DEADLY SEASON

LAST YEAR, 54 PEOPLE IN NORTH AMERICA LOST THEIR LIVES TO AVALANCHES. THREE OF THOSE DEATHS OCCURRED AT SKI AREAS. THAT'S NOT SUPPOSED TO HAPPEN—EVER. BUT THERE'S ONE THING YOU LEARN ON DAWN PATROL AT PLACES LIKE BIG SKY, MONTANA: IN THE MOUNTAINS, **YOU'RE NEVER COMPLETELY SAFE.**



Ski patrollers protect skiers on avalanche-prone slopes such as Big Sky Resort's Black Rock Gully, shown here, by using explosive charges to pre-emptively trigger slides.

The bomb is the size of a soup can, bright orange, stuffed with two pounds of pentolite—a chalky mixture of TNT and an even more powerful explosive compound known as PETN. Ross Titilah, a 31-year-old ski patroller at Big Sky Resort in southern Montana, ties the bomb to one end of a short nylon rope and triggers the igniter. Ninety seconds until detonation. The other end of the rope is attached to what's known as a bomb tram—a sort of ski lift for explosives that stretches from one fin of rock to another high above the entrance to a steep gully in Big Sky's experts-only area.

The tram is cranked by hand, using a pulley system assembled from parts of an old chairlift, and Ross hurriedly rotates the wheel until the bomb is dangling over the center of the gully, several feet above the snow—giving the shock waves more room to do their work. Ross crouches down, amid swirling snow, and shouts into his radio: “Fire in the hole!”

It's a little after sunrise on March 5, 2009, after a night of intense snowfall, nearing the end of what will prove to be one of the most frightening avalanche seasons in memory, with a total of 54 fatalities in the United States and Canada. That's an average of more than three deaths a week during the height of the season, and the second highest tally since record-keeping began in 1950. But it's not the number of fatalities that made the season so nerve-



→ 01

wracking for patrollers; it's where they took place. Usually, avalanche deaths happen in the backcountry, away from an established ski area. Even a single in-bounds fatal avalanche is considered unusual.

Last winter, there were three. A 27-year-old woman was buried in a slide at Snowbird, Utah; a 21-year-old man was killed at Squaw Valley, Calif.; and a 31-year-old man was swept away in Jackson Hole, Wyo. All the incidents took place on steep, difficult terrain, much like the gullies where Ross and his patrol partner, Steve Emerson, are working now. The Jackson death was especially troubling, since the skier was wearing both a helmet and an avalanche transceiver—a homing device, worn around the torso, that greatly aids in a speedy rescue—and was found by other skiers within 8 minutes. It was still too late. One avalanche forecaster in British Columbia said that North America hadn't seen such unstable conditions in at least 100 years.

Less than 48 hours before my visit, another tragedy took place. A veteran patroller at Squaw Valley, attempting to make a slope safe for the public, was killed in a slide. Patrollers are a tight bunch—fewer than 5000 pros work in the United States, and they frequently visit other areas to swap knowledge and techniques. A fatality impacts the whole community, which is why the Big Sky patrol locker room, normally chatty and caffeinated even in the pre-dawn dark, felt somber and a touch nervous when I arrived.

Big Sky is one of the more awe-inspiring resorts in North America, centered around a solitary pyramidal mountain—Lone Peak—which can be skied right from the summit. I arrived following one of the winter's biggest storms, which dropped more than a foot of snow amid fierce winds. The easiest thing to do, when faced with an unstable snowpack, is simply keep most of the mountain closed. Sometimes this happens. But a patroller's job is a tricky juggle between mitigating natural dangers and satiating skiers' desires. To an avid skier or snowboarder, there's nothing more joyful than flying through steep, untracked snow—precisely the scenario that's most uncertain in terms of stability. The compromise is that, after a storm, the patrol activates the most slide-prone areas by detonating powerful explosives.

High on the flanks of Lone Peak, in the moments before the bomb hanging from the tram is set to explode, Ross and Steve instinctively scan the surrounding slopes, reading the terrain with practiced eyes. "Flagged there," says Ross, indicating a line of evergreens whose branches have been sheared off on one side where previous avalanches have swept close by. "Point release," Steve says, motioning with his chin to a



→ 02

spot where a cliff band, warmed by the rising sun, is naturally shedding the new powder, sloughing little waterfalls of snow.

There's a flash, and a bang—and, for a second, nothing. Then, from down in the gully comes a loud and disconcerting *whoomp*, as if an overloaded bookshelf has snapped its supports and dropped onto the shelf below it, which is close to what has happened. Abruptly, what had looked like an inviting ski run is transformed into a tumbling, churning mass of snow, blasting down the hill—avalanches often exceed 90 miles per hour—leaving in its wake a billowing cloud of snow mist, gorgeous and daunting at once.

This is a relatively small slide. The vertical crown face at the top of the avalanche path—which indicates the depth of the snow slab that broke away—is only a foot tall. Some slides at Big Sky have 13-foot crowns. Still, it's easy to see how, if a skier is caught in an avalanche, escape is virtually impossible. Once the slide is over, though, the slope is considerably safer; it's like a rubber band that has snapped, its tension dissipated.

ONE OF THE MOST TERRIFYING

situations imaginable is to be buried in an avalanche. I know this from firsthand, albeit highly controlled, experience. Several seasons ago, I volunteered to help with the training of Big Sky's avalanche-rescue dogs, which must learn how to sniff out victims trapped beneath the snow. I crawled into a 6-foot-deep hole and created a breathing space by cupping my hands in front of my face as



→03



→04



1. Big Sky's ski-patrol locker room begins to fill as early as 4:30 a.m. On a wall, a poster of an enormous slide has a hand-written caption: "Hopefully, it's not the last thing we ever see."

2. Patrollers carry two kinds of handheld charges. The short, stubby cast primers combine TNT and PETN (an explosive used in blasting caps and land mines). They are more powerful than the orange gel shots,

which are sticks of dynamite.

3. Avalaunchers like this are powered by compressed gas; they lob rockets into dangerous terrain to set off avalanches.

Developed in the late 1950s, they replaced the World War II-era artillery then used for avalanche control.

4. Snow pits let ski patrollers examine snow layers built up over the winter, looking for where a slab may be poised to detach from the layer below. Such pits are also used for stability tests, which apply increasing stresses to a column of snow until it collapses.

patrollers shoveled snow over me. I am not typically a claustrophobic person, and I knew this was a carefully monitored exercise. That said, the 10 minutes that elapsed before the dog found me rank as some of the most frightening of my life. The snow, even just a few feet under, is pitch-dark. It's extraordinarily heavy. I couldn't move. My breathing, clipped and panicky, was amplified in my ears. I've never felt happier to have a dog lick me across my face.

No matter how experienced a ski patroller is, the danger of a particular slope can never be evaluated perfectly. All three in-bounds deaths last winter came on runs that patrollers had deemed safe. All had been bombed, and one had slid.

Avalanche danger is present when two layers of snow, on a moderately steep slope, do not adequately adhere to each other. Every snowstorm has a unique signature. Different flakes—needles, prisms, dendrites, columns, plates—fall at

different temperatures, in varying levels of humidity, and are then baked by fluctuating degrees of solar radiation. When a patroller digs a pit to examine the snowpack, the layer left by each snowstorm can be seen distinctly, like the striations in the walls of the Grand Canyon.

If two adjoining layers are poorly bonded, there's a fault line in the snow—one that, it's hoped, is dislodged by the force of a bomb. But a ski slope can be akin to a minefield. Throw a charge in one spot, and nothing may happen. Put the weight of a skier on another spot just minutes later, and the upper layer can collapse onto the lower and begin to slide—slabs of snow moving downhill like a load of mattresses sliding off a dump truck, escalating in speed and power.

Big Sky has lost two patrollers, one in 1982, in an avalanche, and another on Christmas morning, 1996, when a

CONTINUED ON PAGE 110

A photograph of a rack of audio equipment, likely a multi-channel mixer or recorder. The rack is filled with numerous green cables plugged into various input and output ports. The cables are bundled together and run vertically down the rack. The equipment has multiple rows of inputs, each labeled 'Input 1' through 'Input 8'. Each input has a red 'R' (Right) and a white 'L' (Left) jack. To the right of the inputs are several rows of 'Stereo Outputs' with multiple channels. The overall scene is a close-up, focusing on the intricate wiring and the repetitive nature of the equipment's ports.

***The
Machines...***



Are Watching

Las Vegas casinos are incubators of the world's most advanced surveillance tech. And the spy gear that helps Sin City has taught everyone from government to big banks how to snoop more effectively.

By Michael Kaplan

PHOTOGRAPHS BY TONY LAW

IT IS 2 AM INSIDE THE BUNKER-LIKE SURVEILLANCE room at the Mirage Resort in Las Vegas, but 28 wall monitors show there's still plenty of action down on the floor. A surveillance worker we'll call Tom logs in and starts the graveyard shift, taking an overhead tour of the 100,000-square-foot casino. Using a joystick, keypad and three desktop screens, he surveys video from some of the 1000 ceiling cameras.

Tom is a table-games specialist, so he starts by scrutinizing a few poker hands, then sweeps over medium-stakes blackjack and watches a busy craps table. Nothing looks unusual until he stops at a baccarat game in the high-limit room, where betting minimums start at \$100 per hand. He focuses on a young Asian man in a white suit who keeps his hands curiously positioned. Sometimes they cover the cards in front of him; at other times they rest on the side of the table. Suddenly, the man sweeps one hand up along a lapel of his jacket.

In the surveillance equipment room at the Mirage Resort in Las Vegas, these video encoders process feeds from more than 1000 overhead cameras.

Like many gamblers in Las Vegas, the man presented a players card, the equivalent of a customer-loyalty card, to the dealer before buying into the game. Through these cards, the casino monitors the play of guests and dispenses complimentary goodies accordingly (risk enough money, and you may wind up in a villa with a butler). The card enables Tom to retrieve a profile of the player: his name, date of birth, address, amounts won and lost on previous visits and other data.

Tom checks the player's long-term success rate at baccarat: He's a stone-cold loser. Common sense suggests that his poor record should exonerate him. Playing a hunch, Tom uses an internal search engine to correlate every player and dealer that the suspect has gambled with at the Mirage. One name repeats—a big winner, also Asian. On this trip alone, he's ahead hundreds of thousands of dollars, and he happens to be playing right now, at the same table as Mr. White Suit.

Less than an hour later, Tom makes the call. He is convinced that the fellow in the white suit is not rubbing his lapel but dipping his finger inside his jacket. He is swapping cards in and out of the game, a tactic known as hand mucking. Capitalizing on baccarat's simple rules, which allow gamblers to take the side of player or banker, Mr. White Suit loses minimal wagers while his confederate wins large ones from the casino.

When the winning conspirator attempts to cash out his chips, guards detain him. Other guards hustle the mucker from the table. The cheater tries to break free, then drops to his knees and eats the card that he had slipped inside his jacket. He may have swallowed the evidence, but the casino's digital ceiling cameras have captured all of his illicit actions.

Soon after this incident, the Mirage outfitted its baccarat tables with a system known as Angel Eye. A scanner hidden in the shoe—the plastic case out of which cards are dealt for multideck games—reads invisible bar-code strips on the cards. “Angel Eye identifies the cards as they come out and conveys that information to the dealer,” director of surveillance Ted Whiting says. If a player swaps in a card, the dealer knows. “That one change put card muckers out of business here.”

ENTER A MAJOR LAS VEGAS CASINO, AND YOU MIGHT as well be walking into a complex computer built to study your relationship with money, your motivation for gambling, even your taste in food. Cameras capture your every move, software calibrates your play, and regressive-analytic applications (like those used on Wall Street to predict a stock's future) estimate your long-term worth to the casino.

Given the wild bets taken recently by investment banks, the overlap of gambling and financial technology may not be surprising. But the innovations pioneered for Las Vegas surveillance rooms have significance and applications that reach a lot farther than a trading floor. According to Dave Shepherd, former executive director of security at the Venetian Resort Hotel Casino, Las Vegas is an ideal proving ground for innovations that eventually end up in airports, shopping malls and government agencies. “There is no Underwriters Laboratory for security technology,” says Shepherd, who serves on a casino-focused council affiliated with Homeland Security. “Casinos use the earliest versions of security and surveillance devices. People in other industries see how they work, and those people come up



Three types of cameras feed the video wall in the Mirage's surveillance room. Fixed-field-of-view units focus on tables, motorized pan-tilt-zoom cameras survey the floor, and 360-degree cams take in an entire area.

with fresh applications for the technology.”

Vegas's gaming industry, after all, has the resources and incentives to be a pioneer in surveillance tech and data mining. “Casinos employ the most talented cryptographers, computer security experts and game theorists,” says John Pironti, chief information risk strategist for Archer Technologies, a Kansas-based company that specializes in data protection. “Casinos are vulnerable and have a vested interest in being innovative.”

A modern Vegas property is a microcosm of a wider world, with restaurants, a hotel, entertainment venues, retail shops and a sophisticated system of currency exchange. It's all in a highly controlled environment where customers eagerly volunteer personal data for a chance at comps. As a result, casinos maintain a treasure trove of information on customer behavior that most marketers would die for. Players cards and gambling in general are opt-in propositions. The casino industry is highly regulated, and the watchful tech is not only legal but, in many cases, mandated. Still, the opaqueness of the programs is a cause of concern for some privacy advocates. “Why should casinos have secret files on their best customers?” asks Marc Rotenberg, executive director of the Electronic Privacy Information Center (EPIC). “People should know the information that casinos gather on them.”

Digital data has a long memory, and effective surveillance technology spreads fast. The software that measures your gambling skill at the blackjack table today could be gathering data

MONITOR # 16

MONITOR # 17



MONITOR # 18

MONITOR # 19



MONITOR # 13



CEC-CMH10A

PROFESSIONAL DISPLAY SYSTEM
CCTV COLOR MONITOR

MONITOR # 14



CEC-CMH10A

PROFESSIONAL DISPLAY SYSTEM
CCTV COLOR MONITOR

MONITOR # 11



CEC-CMH10A

PROFESSIONAL DISPLAY SYSTEM
CCTV COLOR MONITOR

MONITOR # 12



CEC-CMH10A

PROFESSIONAL DISPLAY SYSTEM
CCTV COLOR MONITOR

for your performance review at work tomorrow.

Paying close attention to customers is as much a security concern as it is a marketing opportunity for casinos. From the moment you place your first bet with your players card, the casino starts paying attention. "That financial transaction feeds into a data-warehousing platform," says David Norton, chief marketing officer of Harrah's Entertainment. The most direct interface with the system is a modern slot machine. These days most slots are run by computers, and until recently, all of these computers have been self-contained machines. To make adjustments on standard slots, attendants have to stop

play, open the housing and swap out chips, a time-consuming process that reduces profits for the casino. The Mirage's soon-to-open sister property, Aria Resort & Casino, however, will be the first casino in Las Vegas outfitted with server-based slot machines. That means Aria's one-armed bandits will run off a single computer, allowing supervisors to alter machines simply by pushing backroom buttons that can change games, odds and limits to suit the player or the situation. If a player is in town for the National Finals Rodeo, the slot machine could load up a game with a rodeo theme, and alert the player when certain comps kick in or provide the showtimes of events he

Data Jackpot

Las Vegas's gaming industry invests in the best surveillance and behavioral monitoring technology in the world. But casinos aren't the only ones interested in high-tech snooping. Here's who's looking at you.



License-Plate Reader

Many casinos know who you are before you even walk through the door. At the self- and valet-parking areas of the Mirage, for example, cameras scan the license plates of vehicles as they enter. Pictures of every plate are then run through optical character-recognition software. If your plate matches a database of undesirables, the security personnel may hand back your keys and suggest you take your business elsewhere.

• Beyond Vegas

License-plate scanners are now commonly deployed in police patrol cars to check traffic for suspect vehicles.

Eye in the Sky

Thousands of cameras built into the ceiling can cover more than 80 percent of a casino. Computer-vision systems automatically scan for suspicious activity on the floor (people congregating in odd areas, unattended bags) as well as at the tables (dealer errors, cheating players).

• Beyond Vegas

Similar systems are also used by airports to watch for potentially dangerous activity, as well as by retailers such as Best Buy, which uses the technology to monitor traffic patterns in stores and to harvest data on customer shopping behavior.



Smart Tables

Several systems kick in once you get to the table: Cards printed with invisible bar codes discourage deceitful players from swapping in fakes; non-obvious relationship awareness (NORA) software determines if you share enough background data with the dealer to be suspected of collusion; and analytic programs determine your skill as a player.

• Beyond Vegas

Developed for casinos, NORA technology is now used by Homeland Security to look for ties between suspected terrorists. Banks and insurance companies also use NORA to sniff out relationships between customers.

might be interested in. It'll even wish him happy birthday.

All the personal attention may seem flattering so long as the casino values your business. But what about those people who are viewed as undesirable? At the Venetian Resort Hotel Casino, special software allows security workers to enter a suspected bad guy's characteristics (a mustache, say, along with a forearm tattoo and a habit of lurking around roulette tables). If there is a visual match from the casino's database, it pops up on the screen, along with identification data. "We have a lot of coverage, a lot of cameras, a lot of information," says Dan Eitnier, head of surveillance at the Venetian. "A couple of years

ago we had a collusion situation, and by finding the suspected dealer's car-loan application in our file on him"—the lender had asked the Venetian to confirm his employment there—"I saw that he gave one of his frequent players as a reference." The scheme unraveled from there, and both men were busted. New algorithms have elevated this type of on-the-spot background check to a Vegas art form. Non-obvious relationship awareness (NORA) software allows casinos to determine quickly if a potentially colluding player and dealer have ever shared a phone number or a room at the casino hotel, or lived at the same address. "We created the software for the gaming



RFID Chips

Money talks in Vegas, but your chips speak in code. Some casinos, such as Wynn Las Vegas, have high-frequency radio transceivers hidden in the chips. The technology can be used to confirm that the chips are legit and can also be used for real-time accounting, so that management knows where the money is at all times.

• Beyond Vegas

Tiny, cheap RFIDs are so pervasive that millions of people carry at least one of these trackable transceivers on themselves at all times, in the form of a corporate ID, contactless credit card or toll-collection pass.



Networked Slots

Server-based computerized slot machines allow casino management to change games and set odds remotely, then push games out to each machine from a centralized location. When used with a loyalty card, the game can track betting patterns and deliver a customized game to the player.

• Beyond Vegas

Slot machines all operate using a complex algorithm known as a random-number generator. And the same type of program that determines jackpots is also useful for high-tech cryptography, which protects government secrets via encryption.



Cashier's Window

The cashier's window is the last line of defense against those who try to take advantage of the house. Automated document scanners can determine if an ID is valid before a cashier dispenses a credit card advance for chips. If things don't match up, an automatic call goes to security before the perp or cashier even realizes there's an issue.

• Beyond Vegas

Real-time document verification scanners are used to instantly check the authenticity of IDs at border crossings, banks and nightclub doors.

industry,” says Jeff Jonas, founder of Systems Research & Development, which originally designed NORA. The technology proved so effective that Homeland Security adapted it to sniff out connections between suspected terrorists. “Now it’s used as business intelligence for banks, insurance companies and retailers,” Jonas says.

According to EPIC’s Rotenberg, any industry that collects so much data on its customers is at risk for a computer security breach. “Even if casinos have no interest in using their information for any purpose other than the intended one, things don’t always go as planned.” Especially, he points out, since security teams at competing casinos often share information.

With all the data collection and camera monitoring going on in casinos, a sense of gambler’s paranoia is understandable. But it’s worth remembering that the same technology that protects the house could end up protecting you. Casinos are tempting places for pickpockets; customers stroll the floors with cocktails in their hands and thousands of dollars in their pockets. Some of the sexiest-sounding software—facial-recognition systems that promise to set off alarms as soon as a known criminal enters the property—is still too primitive to be useful. However, more reliable analytic software is employed in casinos such as the Mirage to monitor video feeds for suspicious activity—someone hiding in a stairwell, for example, or a purse left unattended too long.

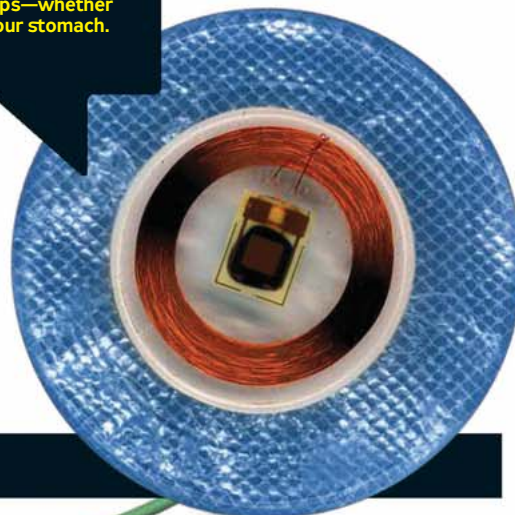
THE MOST ADVANCED SURVEILLANCE TOOL IN THE gaming industry is focused on the blackjack tables at Barona Resort & Casino in Southern California, where management aggressively tests new technology. The system, called TableEye21, was created by Canadian computer engineer Prem Gururajan to profile and rate players according to skill.

TableEye21 uses overhead video cameras and video analysis software, and can track information from casino chips embedded with radio frequency (RFID) transmitters. The system quickly identifies “advantage” players who can cost casinos profits. These gamblers use legal strategies such as card counting and shuffle tracking, in which the player watches for clumps of favorable cards. Gururajan says TableEye21 will be coming online soon at a Vegas casino, and surveillance specialists are enthusiastic about the product. “You get a printout of the player’s skill level, how much you can expect to win from him and whether the dealer is making errors,” Gururajan says. “Since the system tracks the player’s bets, the casino knows exactly how good a customer the player is.”

Sometimes, casino monitoring can go too far. A few years ago a product called MindPlay hit the market. Fourteen tiny

Inside an RFID chip: This casino chip from manufacturer Gaming Partners International has an internal transceiver that can communicate with sensors in a table to spot counterfeit chips and track how much money is being won or lost, in real time. According to veteran security director Arnie Rothstein, casinos can also use RFID to prevent employee fraud by positioning sensors near the employee exits.

Sensors can detect these chips—whether they’re in your pocket or in your stomach.



cameras photographed cards as they came out of the blackjack shoe. The system’s software executed a quick bit of analysis and notified dealers, in real time, whether shoes were cold or hot—that is, when the remaining cards favored players. “That would be a good time for the casino to come up with an excuse to shuffle,” says veteran security director Arnie Rothstein. “Players found out about it and complained to the Gaming Control Board.” The product, according to its manufacturer, is no longer in use.

Inside his plushly carpeted surveillance lair at the rococo Venetian, Dan Eitnier inspects the flat-screen monitors on the walls. He acknowledges that technology runs both ways in the gaming business: The operators aren’t the only ones who capitalize on cheaper bytes and easy access to data.

Eitnier admits that all casino games are vulnerable. Enhancements in technology have simply added another layer to the endless cat-and-mouse game played by those who are paid to protect casinos and the renegades who get rich by out-thinking the protectors. “Whenever new technology is introduced, you always have people out there who want to beat it,” he says. Cheaters buy and dissect slot machines, angle-shooters analyze automatic shufflers in search of patterns, and card counters continue to stymie facial recognition. “They find weaknesses in the technology, and then we come up with new technology that they have not yet figured out.”

Eitnier leans back in his chair and keeps his eyes on the monitors. He smiles. “Of course,” he says, “without those people trying to beat everything, I wouldn’t have a job.” **PM**

DR. COLORCHIP DIY AUTOMOTIVE PAINT CHIP REPAIR KIT



Repairing paint chips from highway driving has never been so easy nor been so effective. Rated #1 by the Wall Street Journal among do-it-yourself paint repair products, the **Dr. ColorChip** 1-color kit offers fast, simple, professional results without the usual paint blobs associated with regular touch-up paint. Simply dab on the paint, smear it over the chips, then use the solution provided in each kit to blend away all the excess paint. This kit works wonders on hoods that have that fine speckled damage or that "shotgun blasted" look where it would be impossible to touch up using regular paint. Each kit is custom-made to match your car color.

Visit www.drcolorchip.com for more information.

MECHANIX WEAR'S NEW MRT® GLOVE DESIGN



The all-new **MRT® (Mechanix Racing Technology) 0.5 M-Pact®** Glove continues our tradition of cutting edge, race developed products. It offers both high dexterity and protection. A honeycomb exoskeleton integrates with a specially-designed rubber knuckle ribbing for top-of-hand protection. It has a 2-stage palm of

thinner 0.5mm dimpled Clarino Septon in the fingers and dual-layer EVA foam palm panels for impact protection. The fingertips and partial palm are also overprinted for an ultra grip. This glove has it all. Mechanix Gloves. The Tool That Fits Like A Glove.®



Visit www.mechanix.com/search/all-gloves for more information.

THE GOODS

GREAT PRODUCTS AND PROMOTIONAL
OFFERS FROM PM ADVERTISERS

zMAX MICRO-LUBRICANT®

zMAX Micro-lubricant® helps keep your engine's combustion chambers at their peak performance. An application of 12 oz in the crankcase (best after an oil change) and 12 oz into the fuel system (tank should have a minimum of 5-gallons when installed) can help improve mileage by its primary characteristic of soaking into metal thereby dispersing carbon around the piston rings and around the valves, creating a more powerful engine that requires less gas to run.



Visit www.zmax.com to locate a dealer near you.

PUROLATOR PUREONE OIL & AIR FILTERS

Here's a callout to the purists. Guys choose **Purolator PureONE** oil and air filters because they know what you get out of something is directly related to what you put into it. PureONE oil filters are the most efficient on the market — 99.9% efficient — trapping microscopic contaminants that

can harm your engine. We invented the oil filter. And we continue to perfect it.



Visit www.purolatorautofilters.net for more information.

+ PM TEST DRIVEN

THRILL RIDES

GRAB YOUR HELMET—PM HAMMERS SIX THRIFTY SPORT MACHINES ON THE TEST TRACK.

→→ by LARRY WEBSTER →→ photographs by CHRISTOPHER WRAY-MCCANN



↖ MITSUBISHI
LANCER RALLIART

↑ MAZDA
SPEED3

↗ CHEVROLET
CAMARO V6

➔ **A romp on an empty back road with the right car** can deliver a double shot of high-performance fun. When the chemistry is just right, the driver melds into one harmonious bond with the hardware. Yet the cognitive man-machine mashup isn't the exclusive domain of the six-figure sports car. There are plenty of inexpensive rides that deliver a hardcore mission—with little fluff.

We gathered six of the newest cheap speed machines and divided them into three groups based on driveline. In the rear-drive class, the Chevy Camaro V6 went tire-to-tire with the Hyundai Genesis Coupe 2.0T. Driving all four wheels, the Subaru Impreza WRX took on the Mitsubishi Lancer Ralliart. In the front-drive class, the new VW GTI battled the Mazdaspeed3.

We tested each car at Chrysler's Chelsea, Mich., Proving Grounds, then blitzed the rural Ohio back roads before spending two days on the Nelson Ledges Road Course. This 2-mile, seven-turn racetrack is just as tough and gritty as our sporty steeds. The rough, pockmarked surface chews up tires, and the undulating pavement puts a beating on any suspension system. Hot laps around the track—and the time spent swapping stories of the day's adventures—were invaluable to our testing regimen. And, yes, extraordinarily fun too. Sure, we burned up plenty of rubber and fuel to get the quickest times. But speed was not our sole criterion. These cars were judged on how well they connected with the driver and how enjoyable they were to drive in all conditions.

POPULARMECHANICS.COM | JANUARY 2010 **81**



↑ HYUNDAI
GENESIS COUPE 2.0T

↑ VOLKSWAGEN
GTI

↑ SUBARU
IMPREZA WRX

REAR- WHEEL DRIVE



→ **The Good:** Equal division of labor—the front wheels turn, and the rears put down the power, so the only limit on horsepower is traction. The car's weight is more evenly distributed, which works all four tires equally in the turns. → **The Bad:** The driveshaft tunnel soaks up interior space. On slippery surfaces, traction is an issue, and when the tires break loose, a rear-driver tends to fishtail. → **The Bottom Line:** Generally, the best option for optimum, neutral handling. A required layout for lurid power slides.



CHEVROLET

CAMARO V6

→ PM editors (from left) Larry Webster, Ben Stewart and Mike Allen examine Hyundai's new turbo four-cylinder.



↗ You won't find a car that turns more heads for less money than the Camaro. Folks still stop and stare at this concept car come to life, likely unaware of its basement-level \$22,995 entry price. In keeping with the spirit of the test, we skipped the V8 option and tested the less-expensive 304-hp V6 paired to the six-speed automatic. We were surprised at the powertrain's effectiveness. The 24-valve V6 pulls briskly and manages to haul the hefty 3779-pound coupe into 14-second quarter-mile territory. Better still, the Camaro returned an excellent 26.55 mpg—the second best in this test.

The Bowtie bruiser, however, had some chassis deficiencies. The Camaro was

impressive in our handling tests and managed a second-best run around Nelson Ledges, thanks to its tenacious grip. But the steering wheel jitters over bumps, and it feels like a layer of molasses coats every engagement point between you and the road. The Camaro is isolated and aloof. The gun-slit windows offer poor visibility and create another layer of fog between the driver and the road. Of all the cars here, the Camaro's design is universally striking. But even that 1960s cool couldn't create a lasting bond with our testers when we pointed the Camaro's nose toward twisty roads. The Camaro's beauty does go beyond skin deep, but not as much as it should.

↙ **Earlier this year,** our testing placed the performance of the V6 Genesis Coupe within a stopwatch tick of the Infiniti G37 Coupe. Impressive. Unfortunately, the lower-price 210-hp four-cylinder motor doesn't deliver the same thrills. But a powerplant is only one part of the package. The rest of this car, especially the chassis, is magic. Our test unit wore the optional Track pack with a stiffer suspension. Thus equipped, the ride is a bit rough. Upside? The handling moves three notches up the crispness scale. The Hyundai digs in and drifts beautifully—as a proper rear-drive car should. The suspension deftly communicates the moves those tires make, right up the steering column and into the driver's hands. This Hyundai bestows confidence in the driver in every corner and on every lap. The stability-control system intervenes gently, and the brakes are powerful, offering fade-free performance on the track. The Hyundai really bonds with the driver, and that, in turn, inspires the driver to use every bit of performance the chassis offers. After all, a willing partner is always better—and more fun—than a powerful but indifferent companion.

	CHEVROLET Camaro V6	HYUNDAI Genesis Coupe 2.0T
Base price	\$22,995	\$22,750
As tested	\$28,030	\$27,675
Powertrain	304 hp/273 lb-ft 3.6-liter V6, 6A	210 hp/223 lb-ft 2.0-liter turbo I4, 6M
Suspension (f/r)	strut, coil springs/ multilink, coil springs	strut, coil springs/ multilink, coil springs
Wheelbase (in.)	112.3	111.0
Length (in.)	190.4	182.3
Width (in.)	75.5	73.4
Track (f/r)	63.7/64.1	63.0/63.6
Axle ratio	3.27:1	3.91:1
Brakes (f/r)	12.6-inch disc/12.4- inch disc ABS, ESC	13.4-inch disc/13.0-inch disc ABS, ESC
Curb weight	3779	3401
Power to weight (lb/hp)	12.43:1	16.20:1
Tires (f/r)	245/45ZR20/ 275/40ZR20	225/40R19/245/40R19
Acceleration (sec)		
0–30 mph	2.69	2.64
0–60 mph	7.02	7.79
0–100 mph	17.09	20.63
0–120 mph	26.25	34.12
40–70 mph	4.99	6.03
Quarter-mile (sec/mph)	14.98 @ 93.99	15.65 @ 88.06
Braking (ft)		
30–0 mph	27.91	28.58
60–0 mph	111.00	114.95
Sound levels (dBA)		
Idle	60.0	60.0
Full throttle	76.0	77.0
60 mph	73.0	73.0
Slalom (mph)	48.98	49.94
Lane change (mph)	64.94	66.63
Skidpad (g's)	0.89	0.87
Lap time (min)	1:21.2	1:22.5
EPA fuel economy (city/hwy)	18/29	21/30
PM fuel economy	26.55	25.79

HYUNDAI

GENESIS COUPE 2.0T





While numbers don't

accurately portray the Mitsubishi's talents, the WRX's figures speak volumes. The 265-hp flat four-cylinder engine is burdened with only 3235 pounds to pull around the racetrack. And unlike the traction-challenged Mazdaspeed3, the WRX has all-wheel drive—so every pony is channeled to the ground. The WRX is a scrappy, point-and-shoot

specialist. The blown motor suffers little turbo lag and dispatches straights with startling brevity. Directional changes take an aggressive hand. You pitch this car, rather than delicately thread an arc, and count on the all-wheel drive to handle corner exits. While the WRX has an excellent, everyday, plush ride, it leans dramatically into the corners. And the body heaves and bobs, which makes the driver

wonder just which way the car wants to go. The brakes are another confidence killer because they fade quickly and the pedal gets spongy. Finally, there's the overly stiff clutch, which really saps the fun of rowing the manual gearbox.

The leather-wrapped steering wheel falls perfectly to hand, and the seats are all-day comfortable. Better quality interior plastic, however, would be more fitting in this \$30,000 car.

Though the WRX includes heated seats, automatic climate control, Bluetooth and touchscreen navigation, we'd skip all of it for a tauter suspension to match the Subaru's straight-line speed.

+ PM TEST
+ DRIVEN

ALL-
WHEEL
DRIVE



→ **The Good:** It has roughly double the traction of two-wheel drive and isn't hampered by weight transfer. Handling can be affected by how the power is divided between the axles. AWD allows automakers to raise horsepower without increasing torque steer.

→ **The Bad:** Not only is the hardware expensive, the extra weight and mechanical drag hurt fuel economy. → **The Bottom Line:** Just because an AWD car can accelerate quickly in snow, that doesn't mean it can turn or stop any better than its 2WD brethren.

SUBARU

IMPREZA WRX





MITSUBISHI
LANCER RALLIART

WINNER

➤ **The Ralliart is a** perfect example of why hard test numbers often fail to tell the whole story. The car is not as powerful or outrageously quick as some. But the Mitsubishi's engaging personality extends far beyond the spec sheet.

The Ralliart's all-wheel drive and dual-clutch transmission make the Mitsu heavy, but they meld into a car that's a tactile delight. Ours included a set of fantastically supportive front seats. The steering wheel has just the right thickness. And a pair of gorgeous magnesium

paddles that wouldn't be out of place in a Ferrari flank the wheel and operate the gearbox.

Ergonomically, the Mitsubishi is close to perfection. And while the ultimate grip is low, you always know exactly what the tires are doing. This car doesn't pound the pavement; it conforms to it, deftly accommodating any surface. It's sublimely balanced. That capability imparts confidence. We comfortably explored up to and beyond this car's limits on the racetrack. The Ralliart makes you look and feel like a better driver.

	SUBARU <i>Impreza WRX</i>	MITSUBISHI <i>Lancer Ralliart</i>
Base price	\$26,885	\$28,310
As tested	\$30,690	\$31,060
Powertrain	265 hp/244 lb-ft 2.5-liter turbo flat 4, 5M	237 hp/253 lb-ft 2.0-liter turbo I4, 6 auto-manual
Suspension (f/r)	strut, coil springs/ multilink, coil springs	strut, coil springs/ multilink, coil springs
Wheelbase (in.)	103.1	103.7
Length (in.)	173.8	180.0
Width (in.)	68.5	69.4
Track (f/r)	58.9/59.3	60.2/60.2
Axle ratio	3.90:1	4.06:1
Brakes (f/r)	11.6-inch disc/11.3-inch disc ABS, ESC	11.6-inch disc/11.9-inch disc ABS, ESC
Curb weight	3235	3616
Power to weight (lb/hp)	12.21:1	15.26:1
Tires (f/r)	225/45R17	215/45R18
Acceleration (sec)		
0–30 mph	2.21	2.45
0–60 mph	5.81	6.52
0–100 mph	15.49	17.55
0–120 mph	24.21	28.99
40–70 mph	4.37	5.01
Quarter-mile (sec/mpg)	14.17 @ 96.72	14.81 @ 93.34
Braking (ft)		
30–0 mph	28.36	30.43
60–0 mph	112.44	120.38
Sound levels (dBA)		
Idle	60.0	60.0
Full throttle	74.0	77.0
60 mph	71.0	73.0
Slalom (mph)	50.53	50.43
Lane change (mph)	66.84	66.84
Skidpad (g's)	0.87	0.84
Lap time (min)	1:21.2	1:22.9
EPA fuel economy (city/hwy)	18/25	17/25
PM fuel economy	27.88	24.00

FRONT- WHEEL DRIVE



→ **The Good:** Combining the engine, transmission and differential into one compact unit mounted ahead of the firewall saves interior space and weight. The car's mass, concentrated over the driven wheels, increases traction. → **The Bad:** The front wheels have two tasks: steering and propelling the car. Handling suffers because the cars tend to be nose-heavy. And front-drivers struggle with torque steer (the car darts from side to side under power). → **The Bottom Line:** There's a limit to how much power an FWD car can handle.

MAZDA
SPEED3



though the engineers tuned in ride comfort at the expense of handling. Those extra body motions erode driver confidence.

There's flypaper-like grip from the big tires, and the Mazda is benign when that grip runs out. But the steering tends to wander under full power and, yes, launching hard in first gear, you feel the torque tug in your hands.

The Mazda's muscular rawness split our testers down the middle. Some loved its hair-on-fire urgency. Others thought the Mazda needed all-wheel drive to tame that power. Inside, the dash is awash with too many buttons. The materials are a little low-rent and a little unsophisticated. Those gripes aside, the Mazda's combination of a bargain price tag (under \$24,000) and outright speed make it the undisputed bang-for-the-buck winner of this test.

↖ In the hot hatchback class, the Mazda-speed3 is the bully. Armed with 280 lb-ft of torque and 263 hp, the Mazda smokes the front tires at will. That much grunt requires a delicate balancing act at the dragstrip—too much throttle bakes the tires; too little, and the motor bogs. But don't be fooled by the Mazda's seemingly unremarkable acceleration times compared to the others; it's a rocket. The racetrack lap times tell a more accurate story—it outran everything by nearly 2 seconds. Driven aggressively, the body moves more than the taut GTI. It feels as

→ At the helm of the Camaro, PM's Larry Webster takes a cool-down lap before testing the next car.



↘ The new GTI carries the VW performance torch lit 27 years ago by the very first Rabbit GTI. And it is impressive. The GTI may be down on power compared to most here, but VW's performance defies hard numbers—it's so full of heart and spunk that we felt an immediate bond with it. The steering is nearly telepathic. The body motions are tightly controlled, yet the chassis doesn't hammer occupants over rough-patched roads. The brake pedal summons the perfect linear response too. Equipped with the Direct Shift Gearbox (DSG), an automated dual-clutch transmission, the GTI performs brilliantly quick shifts. The engine snarls with a sinister but sophisticated exhaust note that

wouldn't be out of place on a \$50,000 Audi sports car. And it sounds hauntingly good, howling along the front straight at Nelson Ledges. The responses from this car are so precise, it feels as though you could take one corner at maximum speed over and over again and make the tire contact the same square foot of pavement every time. No surprise then, the GTI was the fastest in our handling tests.

Inside, the GTI has the highest quality interior of all six cars. Everything feels solid and crafted from materials normally found on cars one price class up.

The scope of this car's capabilities is impressive. Fold the rear seats, and it holds 46.1 cubic feet of whatever you're packing. More importantly, the VW is not only a responsive little road burner—it provides a more cohesive package than just about any car here. **PM**

	MAZDA Speed3	VOLKSWAGEN GTI
Base price	\$23,945	\$23,990
As tested	\$25,840	\$28,084
Powertrain	263 hp/280 lb-ft 2.3-liter turbo I4, 6M	200 hp/207 lb-ft 2.0-liter turbo I4, 6 auto-manual
Suspension (f/r)	strut, coil springs/ multilink, coil springs	strut, coil springs/ multilink, coil springs
Wheelbase (in.)	103.9	101.5
Length (in.)	177.6	165.8
Width (in.)	69.7	70.0
Track (f/r)	60.4/60.0	60.4/59.7
Axle ratio	3.53:1	3.14:1
Brakes (f/r)	12.6-inch disc/11.0- inch disc ABS, ESC	12.3-inch disc/11.3-inch disc ABS, ESC
Curb weight	3272	3159
Power to weight (lb/hp)	12.44:1	15.80:1
Tires (f/r)	P225/40R18	225/40R18
Acceleration (sec)		
0–30 mph	2.38	2.61
0–60 mph	6.82	6.43
0–100 mph	16.5	16.91
0–120 mph	23.84	27.49
40–70 mph	4.43	4.77
Quarter-mile (sec/mpg)	14.73 @ 97.44	14.73 @ 94.42
Braking (ft)		
30–0 mph	27.54	28.81
60–0 mph	115.37	115.66
Sound levels (dBA)		
Idle	60.0	60.6
Full throttle	78.0	72.0
60 mph	75.0	74.0
Slalom (mph)	52.59	52.59
Lane change (mph)	66.41	67.96
Skidpad (g's)	0.90	0.90
Lap time (min)	1:19.4	1:22.3
EPA fuel economy (city/hwy)	18/25	24/32
PM fuel economy	23.76	26.48



HARBOR FREIGHT TOOLS

Quality Tools at Ridiculously Low Prices

FACTORY DIRECT TO YOU!

How does Harbor Freight Tools sell high quality tools at such ridiculously low prices? We buy direct from the factories who also supply the major brands and sell direct to you. It's just that simple! Come see for yourself at one of our 330 STORES NATIONWIDE and use this 20% OFF Coupon on any of our 7,000 products. We stock Automotive products, Shop Equipment, Hand Tools, Tarps, Compressors, Air & Power Tools, Material Handling, Woodworking Tools, Welders, Tool Boxes, Outdoor Equipment, Generators, and much more.

NOBODY BEATS OUR QUALITY, SERVICE AND PRICE!

WHY WE HAVE 10 MILLION SATISFIED CUSTOMERS:

- ✓ We Buy Factory Direct and Pass the SAVINGS on to YOU!
- ✓ Shop & Compare Our Quality Brands Against Other National Brands
- ✓ 7000 Tool Items In-Stock!
- ✓ NO HASSLE RETURN POLICY
- ✓ Family Owned & Operated

LIFETIME WARRANTY
ON ALL HAND TOOLS!

SUPER COUPON!

20% OFF

ANY SINGLE ITEM!

Bring this coupon and Save 20% on one single item purchased at Harbor Freight Tools. Cannot be used with any other discount or coupon. One coupon per purchase. One coupon per customer. Coupon not valid on prior purchases or purchase of gift cards or purchase of extended service plans. Offer good on in-stock merchandise only. Savings discount percentage off Harbor Freight Tools current prices, including sale prices. This coupon cannot be duplicated in any manner including photocopies and computer printouts. Original coupon must be presented in order to receive the discount. All Campbell Hausfeld products are excluded from this offer. This offer is not valid on food or beverage items sold in our retail store. Valid only in Retail Stores through 4/9/10.



79874285

See HarborFreightusa.com/Popmechanic for additional SUPER COUPONS

3000 LB. CAPACITY LIGHTWEIGHT ALUMINUM RACING JACK
U.S. GENERAL
Item 91039 shown
LOT NO. 91039/67408
REG. PRICE \$99.99
\$59.99
SAVE \$40

HARBOR FREIGHT TOOLS - LIMIT 1
These valuable coupons are only good when presented at your nearest Harbor Freight Tools store. Offer Ends 4/9/10. Coupons valid in Retail Store Only. Coupon not valid on prior purchases. Coupon cannot be bought, sold, or transferred. This coupon cannot be duplicated in any manner including photocopies and computer printouts. Original coupon must be presented in order to receive the discount.

MULTIFUNCTION POWER TOOL
CHICAGO
Electric Power Tools
LOT NO. 67256
REG. PRICE \$59.99
\$34.99
SAVE 41%

HARBOR FREIGHT TOOLS - LIMIT 1
These valuable coupons are only good when presented at your nearest Harbor Freight Tools store. Offer Ends 4/9/10. Coupons valid in Retail Store Only. Coupon not valid on prior purchases. Coupon cannot be bought, sold, or transferred. This coupon cannot be duplicated in any manner including photocopies and computer printouts. Original coupon must be presented in order to receive the discount.

CHICAGO HEAVY DUTY 4-1/2" ANGLE GRINDER
Electric Power Tools
LOT NO. 91223
REG. PRICE \$29.99
\$15.99
SAVE 46%

HARBOR FREIGHT TOOLS - LIMIT 1
These valuable coupons are only good when presented at your nearest Harbor Freight Tools store. Offer Ends 4/9/10. Coupons valid in Retail Store Only. Coupon not valid on prior purchases. Coupon cannot be bought, sold, or transferred. This coupon cannot be duplicated in any manner including photocopies and computer printouts. Original coupon must be presented in order to receive the discount.

11 DRAWER ROLLER CABINET
STOREHOUSE
Includes:
• 6 Drawer Top Chest
• 2 Drawer Middle Section
• 3 Drawer Roller Cabinet
LOT NO. 67421
REG. PRICE \$259.99
\$149.99
SAVE \$110

HARBOR FREIGHT TOOLS - LIMIT 1
These valuable coupons are only good when presented at your nearest Harbor Freight Tools store. Offer Ends 4/9/10. Coupons valid in Retail Store Only. Coupon not valid on prior purchases. Coupon cannot be bought, sold, or transferred. This coupon cannot be duplicated in any manner including photocopies and computer printouts. Original coupon must be presented in order to receive the discount.

CENTRAL PNEUMATIC 3 GALLON 100 PSI OILLESS PANCAKE AIR COMPRESSOR
LOT NO. 95275
REG. PRICE \$74.99
\$39.99
SAVE 46%

HARBOR FREIGHT TOOLS - LIMIT 1
These valuable coupons are only good when presented at your nearest Harbor Freight Tools store. Offer Ends 4/9/10. Coupons valid in Retail Store Only. Coupon not valid on prior purchases. Coupon cannot be bought, sold, or transferred. This coupon cannot be duplicated in any manner including photocopies and computer printouts. Original coupon must be presented in order to receive the discount.

CENTRAL PNEUMATIC 3" HIGH SPEED AIR CUTTER
LOT NO. 47077/67425
Item 47077 shown
REG. PRICE \$15.99
\$5.99
SAVE 62%

HARBOR FREIGHT TOOLS - LIMIT 1
These valuable coupons are only good when presented at your nearest Harbor Freight Tools store. Offer Ends 4/9/10. Coupons valid in Retail Store Only. Coupon not valid on prior purchases. Coupon cannot be bought, sold, or transferred. This coupon cannot be duplicated in any manner including photocopies and computer printouts. Original coupon must be presented in order to receive the discount.

CHICAGO 90 AMP FLUX WIRE WELDER
ELECTRIC
NO GAS REQUIRED!
LOT NO. 98871
REG. PRICE \$149.99
\$89.99
SAVE \$60

6" DIGITAL CALIPER
CEN-TECH
Item 47257 shown
Includes two 1.5V button cell batteries.
LOT NO. 47257/98563
REG. PRICE \$29.99
\$9.99
SAVE 66%

We Will Beat Any Competitor's Price Within 1 Year Of Purchase!

330 STORES NATIONWIDE

TO FIND THE STORE NEAREST YOU CHECK:
1-800-657-8001
or HarborFreightusa.com/Popmechanic



diy

Home

← PM's Harry Sawyers used yellow glue and a pneumatic nailer to quickly assemble boxes.

The New Cubism

IF YOU CAN BUILD A BOX, YOU CAN BUILD ALMOST ANYTHING. BUILD 10 BOXES, AND YOU CAN FURNISH A ROOM. **BY JOSEPH TRUINI**

→ **If you're looking** for a way to flex your DIY muscles, then bust out the tools, because we've got the perfect winter woodworking project. It's possible to build a fun and versatile contemporary furniture system that

consists almost entirely of stackable plywood cubes. The beauty of it is that the parts can be arranged in various configurations in minutes, adapting to your needs or sense of design. From these basic parts, we've been able to create shelving, a desk, a work table, a coffee table, a bed—and you can innovate just about any other form of furniture you need.

Choosing Materials

→ **We settled on** $\frac{3}{4}$ -inch-thick maple plywood. It's a relatively expensive material, costing about \$64 per sheet, but for your money you get straight,

INSIDE × BETTER CAULK + BUZZING DIMMERS + FIREPLACE STINK

smooth panels that take stain or a clear finish equally well and can be painted to match or contrast the surroundings.

The core is a group of 10 14-inch-square cubes which can be used as they are or combined with custom-size panels, which are nothing more than a double thickness of $\frac{3}{4}$ -inch plywood. The bottom panel doesn't need to be maple plywood. It can be any flat, smooth stock, such as particleboard.

To give the pieces a finished look and to conceal the exposed edges of the plywood, we used iron-on maple-veneer edge banding. This is absolutely the quickest, easiest way to apply veneer. The banding comes coated with a heat-activated glue. Just press down the veneer with a clothes iron, and it bonds in seconds to the plywood. We used $\frac{13}{16}$ -inch-wide veneer edge banding to cover the cube edges and $1\frac{1}{16}$ -inch-wide veneer to conceal the edges of double-thickness panels.

Cutting the Pieces

→ **We started by** using a circular saw and a relatively coarse and fast-cutting 24-tooth thin kerf blade. With this, we cut the large plywood sheets into easier-to-handle panels. Next, these pieces went through a table saw equipped with a smooth-cutting 80-tooth ATB (alternate top bevel) blade.

For each cube, you'll need two 14 x 14-inch pieces, and two $12\frac{1}{2}$ x 14-inch pieces. We ripped the plywood panels into 14-inch-wide strips on the table saw, and then crosscut each strip into 14 x 14-inch squares. Next, we readjusted the rip fence to $12\frac{1}{2}$ inches and crosscut 14-inch-wide strips

to create the corresponding rectangular $12\frac{1}{2}$ x 14-inch pieces.

Building the Cubes

→ **The plywood cubes** are glued and nailed together with simple butt joints. The $12\frac{1}{2}$ -inch pieces fit between the

14-inch-square pieces to create the 14 x 14-inch units. Spread some yellow glue on a joint, then nail the parts together. To speed up the process, we used a 16-gauge pneumatic finishing nailer and 2-inch nails. You could use a hammer and 2-inch (6d) finishing nails, but it would take quite a bit longer. There are 16 nails in each cube (four nails per joint), which means you have to



Start With a Basic Cube and Go From There

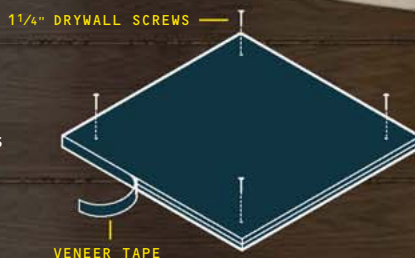
→ A cube is nothing more than four pieces of maple plywood, with iron-on veneer applied to conceal the plywood's layers. It is assembled with yellow carpenter's glue and pneumatic finish nails. To make a larger structure, join cubes using $1\frac{1}{4}$ -inch drywall screws, plywood and construction lumber.



Add a Panel, Make a Coffee Table

→ Cubes become a simple coffee table with the addition of a double-thickness panel. The bottom panel is screwed to the top panel with

1 1/4-inch drywall screws, and the cubes can be nailed to the top panel or screwed to it. Light-duty casters make it mobile and versatile.



drive 160 nails to construct 10 cubes. Also, it's just easier to assemble the cubes so they are perfectly square using a pneumatic nailer. Hold the parts in position with a square held across the corner to be sure the parts are aligned, then fire in a nail. Be sure your supporting hand is well away from where the nail is fired. The pneumatic nailer automatically sets the nailhead.

After the plywood cubes were nailed together, we filled each nail hole with wood filler and then set the cubes aside until the glue cured, about 4 hours.

Veneering Sequence

→ **Cut a slightly overlong** veneer strip using a pair of scissors and place it on the edge of a cube so its edges overhang the plywood's thickness equally on both sides. With the iron adjusted to the (no steam) cotton setting, hold the strip down for 10 to 12

seconds. Once the heat has activated the glue, rub down the veneer edge banding with a wood block. We repeated the process on the other end of the strip to ensure that both ends were firmly bonded.

Here's the sequence that follows the first edge: We applied veneer to the opposite, parallel edge of the cube, and after veneering the first two edges, we cut two pieces of edge banding to fit between the first two. To do the last two strips accurately, and without gaps, simply butt each piece of veneer up to one edge and then mark across it with a square and a sharp pencil where it meets the adjacent veneer. Cut the veneer to length and test its fit. When the crosspieces are cut, they're ironed on to complete the edge banding.

Now you turn to a metalworking tool to trim the veneer to finished size. We like to use a single-cut mill bastard

file to smooth the veneer edges flush with the plywood. Filing is much quicker and neater than sanding, especially when you consider all the edges that must be trimmed on every cube.

It's important to hold the file at a shallow 5- to 10-degree angle, to allow the sharp edge of the file to cut. Also, you're less likely to tear the veneer loose by sweeping the file along the edge, moving it toward the cube, not away. You know you're doing it correctly when your filing action removes a thin strip of veneer rather than creating dust.

Finishing Steps

→ **After building** and veneering all the components, we sanded the inside and outside surface of every cube using an orbital finishing sander. If you're not as fussy as we are, you can just sand the cube's outside. Don't use a belt sander or even a random-orbit sander; those tools are far too aggressive and can easily sand right through the maple

veneer tape. We started sanding very lightly with 150-grit aluminum oxide paper to smooth the surface and level the wood filler, then switched to 220-grit for the final smoothing.

We wiped away sanding dust with a tack cloth and sprayed on a coat of aerosol primer. For a project that will be painted, we prefer a quick-drying, sandable coating such as Kilz Original. It's oil-based and can be topcoated with alkyd or latex. Once the primer dried, we lightly hand-sanded with 220-grit abrasive paper, wiped down the surfaces with the tack cloth and applied a second primer coat. For a clear finish, skip the primer and simply apply two coats of clear polyurethane varnish.

Finally, we lightly hand-sanded all outside surfaces once again with 220-grit abrasive paper, dusted off with a tack cloth and brushed on a coat of semigloss latex paint.

PM

Homeowners Clinic

by Roy Berendsohn

Q+A



Balking at Caulking

Q I hate caulking. Maybe it's me, but I've tried caulk-smoothing tools and masking tape, and it still comes out sort of sloppy and half-baked-looking. Even my kids commented on the sink I caulked. There has to be a better way. Help me out here.

A Clean caulking comes down to three things: the position of the caulk gun, the speed that you move the gun and the opening that you cut in the end of the tube. Sure, gadgets may improve the process, but caulking is a simple DIY skill. Once you learn how to do it, it's easy and predictable without the use of additional devices. It's also a fact that caulk is overused

today. It's not a building material. It's often used to fill gaps and make up for sloppy workmanship, but no matter what you do, it will always look lousy when applied in those circumstances. And while I'm on this soapbox, another culprit is the \$1.99 caulk gun. Stepping up to a pro-level gun that costs just \$5 makes a world of difference in getting caulk to look neat. The pressure you produce with a pro-quality gun is consistent and its pump action is predictable and much smoother.

So let's start with the tube. Cut its tip at about a 45-degree angle. Use a utility knife with a fresh blade in it, or




Plan Ahead

→ Don't start caulking at a random corner or end point. Plan ahead to anticipate what your position will be as you move along the joint. For

an enclosed tub, start caulking at one corner and then reverse the bead at the far end. Caulk outward from the remaining two corners.

use a 1-inch-wide, razor-sharp chisel. The nozzle tip may have lines marked into it to indicate where to cut it. In almost all cases, I find the caulk extrudes more neatly if the tube opening is cut closer to the tip than the manufacturer recommends. A smaller bead is neater and there's simply less material to strike off if you need to clean up the joint with your index finger.

If you find that the bead of caulk is too small, you can always cut a little bit more off the nozzle tip. Finally, if a



"I HAD ASKED A BUILDER TO RECOMMEND A PLACE TO PURCHASE FLOORING FOR MY ENTIRE HOUSE. HE RECOMMENDED LUMBER LIQUIDATORS. I AM THRILLED WITH HOW THE PROJECT TURNED OUT! THANKS FOR HAVING A GREAT SELECTION AND PRICES!"

ANTHONY K., MAPLE VALLEY, WA



"I liked the quality of Bellawood so much, I installed it in my own home." ~ Bob Vila



Bellawood Australian Cypress

Over 185 stores nationwide!
For a **FREE** catalog or a store near you call
800-256-7885 or go to **lumberliquidators.com**.

HARDWOOD FLOORS FOR LESS!
LUMBER LIQUIDATORS\$
www.lumberliquidators.com
1-800-HARDWOOD

DRYLOK® PRESENTS

ASK THE CHEMIST

Q. What is DRYLOK® Masonry Waterproofer?

A. DRYLOK Masonry Waterproofer is a paint that stops water – It is specifically formulated to waterproof interior or exterior, above or below grade masonry surfaces. Ideal for concrete or cinder blocks and poured concrete surfaces. It can be used on basement walls, retaining walls and masonry building exteriors.

Q. How does a waterproofing paint such as DRYLOK work?

A. DRYLOK Masonry Waterproofer is not like an ordinary house paint that simply adheres to the surface. DRYLOK penetrates tiny pores in the masonry; it expands as it dries to form a tough waterproof barrier.


Q. What is the difference between a water sealer and a waterproofer?

A. Water sealers generally only repel water, while a waterproofer must be tested to withstand hydrostatic pressure. Hydrostatic pressure is the pressure exerted by a column of water behind the wall surface. It is measured by PSI (Pounds Per Square Inch). An average basement is 9 feet in height; if water is the full height of that basement it would be equal to 4 PSI. DRYLOK was Independently Tested to meet 10 PSI*.

Have a question for the Chemist?

Visit www.ugl.com/askpm to enter your basement or waterproofing question and earn a chance to win an iPod nano!

iPod is a trademark of Apple Computer, Inc. Campaign ends November 2010
*DL Labs 2008



slight burr remains on the nozzle after you cut it, be sure to remove it by carefully paring with the knife.

Next, hold the caulk gun in the joint so the tube tip meets the surface at a compound 45-degree angle. I'm right-handed, so I usually brace the nozzle with my left hand and squeeze the handle gently while simultaneously drawing the gun slowly down the joint or around the surface. Don't squeeze the handle again until there's an appreciable drop-off in the caulk coming out of the nozzle. Get the timing and pressure right and you can produce long, smooth runs with a single pump of the handle.

Except when starting to run a bead in a corner, I often place the tip of my index finger over the joint. With a little downward pressure, my fingertip smooths the caulk as it comes out. The result is a nice smooth bead that doesn't need further wiping.

When, despite your best effort, you find that the joint needs extra wiping to look good, draw a moistened finger down the joint (assuming you're using a latex or latex blend). If you're using a caulk that requires cleanup with mineral spirits, wear a disposable nitrile glove on the hand that you use to strike away excess material. The glove reduces the wear and tear on your finger and will make cleanup easier when you're done. Peel the glove. Toss it out.

Buzzing Dimmer

I have a dimmer switch that makes a light in my kitchen give off an annoying buzz. What causes this? What can I do to stop the noise?

It's a common complaint, and it's easy to fix if you understand the phenomenon. "The magnetic field created by the current flowing through the bulb's

filament can cause the filament's supports to move," according to Russell Weightman, principal engineer at Lutron, the company that invented the electronic dimmer switch. That movement causes the familiar and annoying buzz.

Some background is helpful. A dimmer is an electronic switch that cuts and restores current to the bulb 120 times a second, literally chopping the current's sine wave. "Think of the filament as a tuning fork," Weightman says. "The normal alternating current is like a soft pillow. Chopped up, the current is more like a hard table.

Strike a tuning fork on a pillow and you won't produce much noise, but it will resonate if you strike it on a table." That resonance is greatest at the midlevel setting because the wave is chopped vertically in half and then goes instantly to its peak when the current is restored. Hence the jolt to the bulb's filament is most pronounced and the buzzing is loudest. Similarly, the buzzing will be more pronounced if you use a high-wattage bulb. Wattage is equal to the voltage multiplied by the current. Therefore, a bulb with a higher wattage draws more current and will produce a louder buzz. Probably the easiest solution is to switch to a lower wattage bulb.

If you need more light than a lower wattage bulb affords, you can also opt to install a rough-service/garage-door-opener bulb with a rugged filament that is less prone to vibration. Finally, if the buzzing persists, you can go so far as to install an electronic lamp debuzzing coil (LDC) in the circuit. Although it sounds fictitious, like a board stretcher, it's real. LDCs (which cost \$100 to \$130) are electronic filters that slow the inrush of current. Now the odd part. They hum softly, so the bulb



1. Cheapo caulk guns tend to extrude a messy bead.
2. A pro gun provides consistent pressure and better feedback.

doesn't. That means you have to wire the LDC in a junction box where the hum won't be noticeable, such as in a basement. It's extra expense, wiring and trouble, so it's usually reserved for troublesome, large-wattage dimming loads.

Smoky Fireplace

Our house was built in 1982, and when we moved in a couple of years ago we noticed a strong smoky odor coming from the fireplace. We've done everything we can to eliminate it, including having the chimney cleaned (twice) and installing a new damper, a new fireplace insert and a new chimney cap. It can be particularly bad in the summer, when the a/c runs. We're reluctant to use the fireplace this winter for fear of making the problem worse.

The problem is probably not with the chimney, the insert or the new hardware—but you're also not the only one dealing with a fairly common issue.

"Chimneys stink all the time," says Ashley Eldridge, director of education for the Chimney Safety Institute of America. "The only question is whether you smell them or not." The problem, he says, is that the air pressure in the house is less than the air pressure outside. That differential is causing air to flow down the chimney, past the comparatively loose-fitting doors on the insert and into the room.

People assume that houses are under negative pressure only in the winter, when the heating system causes more air to be expelled from the house (in exhaust from burned fuel) than enters through infiltration and open doors or windows. But the same thing can happen in the summer. Dryers, bath fans, a combustion-fired water heater, cooking fans and an imbalanced air-conditioning system can result in an out-flow, or an imbalance of air

pressure inside the house.

To check, you'll need a heating-cooling contractor to come in and take some readings using a digital manometer, Eldridge says. This device can measure very small differences in air pressure. Once any pressure imbalances are identified and corrected, the problem should go away. **PM**

Got a home-maintenance or repair problem? Ask Roy about it.

Send your questions to pmhomeclinic@hearst.com or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



RHEEM HEAT PUMP WATER HEATERS

Super efficient!

HP-50

Most Advanced, Energy-efficient Water Heater You Can Own

Rheem air-source heat pump extracts the heat from warm air, intensifies the heat with a compressor, delivers the heat to the water.

2.0 energy factor

Over TWICE the efficiency of standard electric water heaters

- Rheem heat pump technology for superb energy-efficiency
- LED touch pad controls
- Easy to install!
- Standard connections
- 50 Gallon capacity
- Fast first hour recovery

Visit us today! www.rheemhpwh.com
email sales@rheemhpwh.com

\$1500 FEDERAL TAX CREDIT
See tax advisor for details.

ENERGY STAR

Rheem

relax
It's Rheem®

Rheem Water Heating
101 Bell Road • Montgomery, AL 36117-4305
800-621-5622 • rheem.com • sales@rheem.com

RH102109

PM MARKETPLACE

www.MetalRoofSnowGuards.com

IceBlox Inc., D.B.A.
SNOWBLOX
 The Originator of Polycarbonate Snow Guards!

1 (800) 766-5291
 Ph: 717-697-1999
www.SNOIAX.com

Without Snow Guards

With Snow Guards

SnowCatcher Deuce

VentSaver P-383 Up to 14"
 FB-151 Up to 4"

LeafBlox LEAFBLOX

Visit www.SPACINGTOOL.com for Instant Spacing Layouts

**THINK OF IT AS A
 FULL-SIZE VAC THAT FITS IN
 YOUR HAND!**

The all-new Metropolitan® 500 with its incredibly powerful 500-Watt motor makes deep cleaning the interior of any car or truck super fast and easy. It features a rugged steel body with elegant stainless finish, yet weighs less than 3 lbs! Includes all attachments. Made in USA.

**Save space and money...
 build your own
 murphy bed**

do-it-yourself
 mechanism
 Includes
 illustrated
 plans and
 step-by-step
 DVD

Create-A-Bed®
 murphy bed mechanism

TOLL FREE: 877-966-3852
www.wallbed.com

DR. COLORCHIP®
 AUTOMOTIVE PAINT CHIP REPAIR SYSTEMS

Can Your Touch-Up Paint Do This?

BEFORE AFTER

Fast, Simple, Dramatic, Paint Chip Repair
 ...with **NO PAINT BLOBS**

Step 1 - Dab

Step 2 - Smear

Step 3 - Blend

Rated #1 by *The Wall St. Journal*
 among retail paint repair products

- * All Factory Match Colors
- * Permanent Repairs
- * No Clear Coat Needed
- * The Cure for Road Rash

3 sizes: \$39 * \$49 * \$59

Drcolorchip.com
 (866) 372-2548

Order Your Factory Color Kit Today!

LAM-HAMMER JR
 Quick & Easy Floor Tool

\$55
 Includes Shipping

**Use Promo
 Code P10**

**Makes
 Installing
 Laminate Floors
 a Breeze!**

**Designed Specifically for
 the "Do it yourselfers"**

**Eliminates product, wall &
 Cabinet damage**

www.lam-hammer.com
888.687.2421

**PowerBlock
 URETHANE**

KettleBlock™ 40

U-50 Dumbbell

What if... a
 dumbbell,
 could also
 be a
 kettle-
 bell? That
 would be
 smart...

See how at
powerblock.com
 or call
800.446.5215

PexSupply.com

**Plumbing &
 Heating Supplies**

www.pexsupply.com

- Large Selection - Fast Shipping
 - Lowest Prices Guaranteed

Real People. Real Service.
PexSupply.com 888.757.4774

Contact Beth Boyle (914) 461-3269 or beth@specialadditions.com



diy

Auto

Saturday
Mechanic



degree of difficulty | MODERATE

Servicing the Workhorse

DIESELS PROVIDE MOUNTAINS OF TORQUE, GREAT FUEL EFFICIENCY AND UNBEATABLE DURABILITY—BUT ONLY IF YOU TREAT THEM RIGHT.

BY JOHN DECKER

DIRTY FUEL
FILTER

→ **Clattering along**, your diesel pickup returns amazingly good fuel economy, considering the size of the trailer you usually tow. Unfortunately, the truck isn't pulling as hard these days. Now it downshifts several times and struggles to crest grades that it used to conquer easily. A glance in the mirror reveals a thick cloud of black smoke, leaving specks of carbon flecking the pristine fiberglass of your bass boat. Time for a little work under the hood.

Each year, a new crop of diesel cars and trucks are introduced, offering better mileage, torque and driveability, as well as reduced soot and emissions. But properly maintained older diesels die hard. The typical diesel with 200 K on the odometer is just now getting broken in. So you'll want to treat your older diesel well to make it last. Let's get started.

INSIDE

× DIESELS + FLASHER TECH + LUBING CV JOINTS

Clearing the Air

→ **Diesels don't use** throttle plates to limit air intake the way spark-ignition (gasoline) engines do. It's the fuel injection that varies the engine's power output by simply adding more fuel to a fixed amount of air. Diesel air/fuel ratios are much higher than in a gasoline engine, which typically operates at around 14.7:1 air/fuel. Diesel mixture ratios are as high as 100:1 at idle and about 50:1 while driving. (That's one reason diesels use far less fuel at idle than spark-ignition engines.) That means there's a lot of air traveling through a diesel's air cleaner even at idle—essentially just as much as a gasoline engine at wide-open throttle. So diesel air cleaners are larger to allow for all that airflow. They can get dirty quickly on dusty roads, so they need to be checked, cleaned or replaced frequently. A sure sign of a dirty air cleaner element is black smoke from the tailpipe; the dirt restricting the airflow allows the injection pump to flow more fuel than can burn completely, making the engine run too rich—and smoky. Most diesel air cleaners are changed the same way as gas engine filters: Wipe the exterior of the housing down, open the air cleaner box and remove the old air cleaner. Wipe out any dirt, grass or dead bugs, then slip the new air cleaner into position.

Prophylaxis

→ **When a diesel** fuel filter starts to clog, the engine loses power. But this condition will be difficult to discern right away. That's because the engine will run smoothly and cleanly with no hesitation, producing less and less power as the filter becomes more and more plugged. Eventually, you'll notice when cars are whizzing by you on the highway. The good news? Changing the filter will bring back the zip you didn't know you were missing during those many months before.

Fuel filters should be changed

at factory-recommended intervals. But be aware that many fuel filters have a water separator at the bottom of the filter. If so, there will be a valve at the bottom to allow you to drain any water.

Diesel injectors and pumps don't like water, so it's important to keep water out of the engine. Why? A certain amount of water will mix with gasoline, while any water in a diesel tank sinks to the bottom and sulks. When there's enough, it'll be picked up by the pump, where it can damage the delicate, close-tolerance parts in the pump and injectors. Diligence starts at the gas station. It's best to fill up at a station that sells a lot of diesel. Truck stops are great because they go through thousands of

1. GM diesels have an indicator in the intake pipe just aft of the air cleaner. When the air cleaner starts to become clogged, the indicator goes from green to orange, which means it's time for a change. Dodge, Ford and other diesel drivers can buy a Filter Minder at NAPA.

2. The fuel filter lives in here. Prime the filter by turning on the key briefly to fill the housing.

3. Many European diesels have a fully enclosed fuel filter that's attached to the firewall or inner fender. Disconnect

the hoses and replace the entire one-piece filter and housing. Bleed the system a little, then reattach the hoses before reinstalling the filter on the firewall.

4. Diesels will start readily in cold weather—but only if the glow plugs are working, the engine has good compression and the battery and starter are in good shape. A well-used glow plug can burn out just like a light bulb. Test the plugs each autumn to keep your diesel starting all winter. Disconnect the wire or bus bar from each glow plug and connect a test light between the positive battery post and the end of each plug. If the light glows, the plug is working.



Why Diesels Have More Torque

Why do diesel engines work so well when it comes to hauling power and mileage? "It all comes down to expansion ratio," says Gale Banks, the West Coast diesel-engine-building guru and president of Gale Banks Engineering. As Banks explains it, when air and fuel burn, they expand, creating pressure to drive the piston down. Divide the highest pressure when the piston is at the top of the combustion chamber by the lowest pressure when the piston is at the bottom of the cylinder and that's the expansion ratio. (Not to be confused with the compression ratio, the ratio between the maximum and minimum combustion chamber volumes.) The greater the expansion ratio, the more power the engine creates.

There's more: "Diesel fuel has the highest energy density of any fuel we know of," Banks says. (Roughly 10 percent more energy per gallon than gasoline, depending on time of year and the diesel's and gasoline's parent crude.) Combine that energy density with high compression (18 to 22:1 for diesels; gasoline engines are usually between 10 and 12:1) and diesel's ability to resist preignition as it's compressed, and diesel fuel creates a much higher cylinder pressure earlier in the piston's stroke. The result? A much greater expansion ratio, delivering higher torque and better fuel economy.



GLOW PLUG

gallons every day. Condensation and rainwater can creep into underground tanks that aren't in constant use.

And unlike gasoline, diesel fuel can grow bacteria. If the diesel-loving critters multiply sufficiently, they'll quickly clog the fuel filter. All that changing the filter without killing off the bacterial infection will do is give you a brief respite until the bacteria back up in the filter again. The best way to find out if your diesel fuel has a bug problem is to give it the sniff test. If it smells like an outhouse at the end of a busy summer, you've got a problem.

The cure for diesel-borne bacteria is to add a biocide additive (available at gas stations and parts stores) to the fuel to kill the bacteria. Using a biocide during subsequent fueling will keep the problem at bay. However, if the problem is severe, you may have to drain the fuel system completely, or perhaps remove the tank for cleaning.

GM 6.2- and 6.5-liter diesels, like the one we worked on for this story, have a fuel filter between the cylinder heads at the back of the engine. Replacing it is a simple matter of unscrewing a large plastic retaining ring and then lifting the pleated filter from its housing with the tabs on the top of the filter. Before installing the new filter, wipe out the housing. Install the new filter so the holes under the top of the filter line up with the metal tabs on the housing; press the filter into place and screw the retaining ring back

on, then bleed it. Other trucks will have similar, but not identical, procedures. Unlike gas filters, diesel filters are invariably mounted conveniently to facilitate easy, periodic changes.

Let It Bleed

→ **A few short years ago**, all diesel-engine fuel systems had to be bled to remove air whenever work was done to the fuel system, or if the vehicle ran out of fuel or the fuel filter was changed. These fuel injectors are simple spring-loaded poppet valves, forced open by the hydraulic pressure generated in the injection pump. If the steel pipe between the pump and injector has air in it, there won't be enough pressure to force the poppet valve open, and the engine will turn over endlessly but never start. Depending on the vehicle, this means having an assistant crank the engine over as you individually loosen the fuel line to each injector until you see small amounts of fuel seeping out (a lot of fun at night on the side of the road). With the lines bled, the engine starts easily.

But fuel-system maintenance has become easier. On some diesels you'll find a button on top of the fuel filter. Pressing it 10 to 20 times is sufficient to bleed the air out of the system. My Chevy pickup and many others have an electric feeder pump on the chassis directly under the driver's floor pan. Turning on the ignition activates the pump, which allows you to bleed the whole fuel system without cranking the engine. Simply attach a hose to the bleeder screw near the thermostat housing and have an assistant turn the key to the "run" position until bubble-free fuel runs from the hose.

Today, diesel engines with common-rail fuel injection have in-tank primary pumps that feed fuel to the engine and also automatically bleed the system. A word of warning here: Never crack the injector fittings or a fuel line on a pressurized common-rail fuel system, because they operate at 20,000 to 30,000 psi of pressure versus the 1000 to 3000 psi in older systems. A minuscule leak can easily inject fuel through your skin deep into your flesh. Ouch. Diesels aren't just for truckers anymore. A Saturday Mechanic shouldn't have any trouble keeping one running. **PM**



Car Clinic

by Mike Allen

Q+A

Failed Flasher Tech Tip

Q I just picked up a nice used camper trailer. The turn signals all light up, but they flash about three times per second instead of once every 2 seconds. The gentleman who sold me the trailer claims it worked just fine with his truck. My mechanic can't find anything wrong with my car—but I can't even tow the trailer over to him until I get the lights working.

Flasher Basics

Many cars still use a simple two-pin flasher relay, usually easily accessible under the dashboard. Trailering may call for a heavy-duty substitute.



A You need to upgrade your flasher relay to a heavy-duty flasher. Here's how those old-fashioned flashers work. There is a set of switch points attached to a bimetal strip, all in series with the turn-signal bulbs and the battery. When the turn signals are switched on, current flowing through the bimetal strip heats it up, and the strip starts to curl, breaking the circuit. A second or so later, the strip cools off, making the connection again, a sequence that repeats until the signals are canceled. Plug in the trailer, and you're adding two more filaments to draw more current, which makes the bimetal strip heat up faster, accelerating the blink rate. Go down to the auto parts store and get a flasher rated for

towing. It costs around five bucks and plugs right in under the dash. Can't find it? Turn on the signals and follow the click. The heavy-duty flasher either uses a circuit that isolates the bimetal strip from the load, or just does the whole thing electronically.

I sometimes get letters from readers who can't hear the flasher relay at all, regardless of how fast it's blinking. A lifetime of rock-and-roll, high-caliber handguns, motorcycles and race cars

is starting to affect my hearing, too. Fortunately, you have an option. They make special, louder flasher relays that are also dirt cheap. Just substitute one for the old flasher.

Here's the bad news. Many modern vehicles have integrated the flasher-relay function into a fancy-dan lighting-control module, or whatever they call it, and you're stuck with what's built into it. Most of these vehicles will handle a trailer, but the volume of the flasher is fixed. I bet a decent mechanic or one of those shops that installs car stereos could splice in a chime or a buzzer or something, probably for a lot more than the cost of a new relay.

Best (or at least cheapest) solution I've seen was a fellow who epoxied the

Life is short...or maybe not.

Top Harvard researcher says it's "the Holy Grail of aging research."*

...as seen on
CBS "60 Minutes"



Don't wait for the drug companies to drive the price through the roof; get the benefits of this breakthrough *natural* extract for pennies a day!

BOSTON, MA—Leading medical scientists are learning that resveratrol, a natural substance found in red wine, is rewriting the rules on the science of aging.

Researchers at the **Harvard Medical School** and the **National Institute on Aging** already discovered that the red wine extract offset the negative effects of a high-calorie diet in mice and significantly extends their life span (*NY Times*, Nov 2, 2006). Now, the latest research indicates that resveratrol may be even more powerful than first anticipated.

At this moment, drug companies are rushing to create prescription drugs that mimic the awesome health benefits of this simple natural extract. A leading pharmaceutical company has already spent \$760,000,000 on purchasing the research and development.

The powerful secret of tomorrow's anti-aging pill can be yours today.

You may have thought that an anti-aging pill would only be available far into the future. But the effects of resveratrol have been proven as scientific fact... today. Even better, resveratrol is a naturally-occurring substance found in the skin of grapes and red wine, not manufactured in some laboratory. The key to living longer may be found inside your favorite bottle of red wine.

But don't try to drink yourself healthy, because it would take **50 bottles a day!** Now there is a way to take resveratrol without the alcohol, calories and high cost. Vinotrol™,



"We have something (resveratrol) that **extends the life of every species** it's (been) given to. We're 50 years ahead of where I'd thought we would be 10 years ago," said a leading professor of pathology at Harvard Medical School, reported by the *NY Times*.

with 50mg of resveratrol derived from grapes and roots, provides the equivalent of the resveratrol in **278 five ounce glasses of Pinot Noir**.

Such a potent concentrate delivers all of resveratrol's remarkable benefits, promoting circulation, blood flow, immune system, energy and healthy arteries.

Has the "The French Paradox" finally been explained?

Resveratrol is conjectured to be a partial explanation for "The French Paradox," the puzzling fact that people in France enjoy a high-fat diet yet suffer less heart disease than Americans and live significantly longer lives (in some cases up to 40%).

Even though French diets are crammed with loads of bread, cheese, rich cream sauces and decadent desserts... the resveratrol in red wine may have acted as

their secret weapon. It is thought that the resveratrol protected them against unhealthy triglycerides, high cholesterol and skyrocketing blood pressure.

Trick your body into "aging in slow motion"

Reduction in cholesterol, body fat and oxidation is believed to help slow the age process considerably. Not only will you feel better, but the powerful antioxidants in Vinotrol™ will help fight the premature signs of aging. Resveratrol will help protect the collagen and elastin in your skin, which can lead to fewer wrinkles and a more youthful appearance.

Can you live years longer and feel years younger?

What's the point in living longer if you're not going to live better? Resveratrol floods your system with powerful antioxidants and helps flush out lipids and free radicals. Combined with the extra boost to your brain, immune system and everyday energy, you'll wonder how you ever went without this red wine wonder.

Don't wait decades for giant drug conglomerates to figure out a way to charge you a fortune for the same benefits you can get for pennies on your own. Call today!

Having a Hard Time Finding Vinotrol™?

The manufacturer and the laboratories of Vinotrol™ are so confident in their anti-aging technology that they are offering a 30-day, risk-free trial offer. You must call immediately to qualify for the limited number of trials that are available. Start your new anti-aging program today with your risk-free supply of Vinotrol™ (50 mg resveratrol) for just a small shipping and processing fee. Call toll-free 888-861-1072.

Call 888-861-1072 to get your Vinotrol™ 30-Day Risk Free Trial Offer Today!

Mention Promotion Code VL100085 for a Free Upgrade!

These statements have not been evaluated by the FDA. This product is not meant to diagnose or treat any disease. Vinotrol is not endorsed, associated or affiliated in any way with Harvard University, Johns Hopkins, Salk Institute or UC Davis Medical. * CBS News, Nov 1, 2006

Harvard Medical School, Johns Hopkins, Salk Institute and UC Davis Medical Research Proves That Powerful Red Wine Extract Holds the Secret to Living a Longer, Healthier and More Vibrant Life

lid from a tuna can to the standard flasher relay, making a sounding board to increase the volume substantially.

Altitude Correction

My home and shop are at an elevation of 8000 feet. How does this change my readings when doing a compression test on my car?

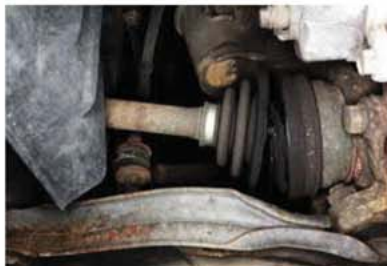
Compression readings are done by removing all the spark plugs, attaching a compression gauge to an individual cylinder and cranking the engine to measure the maximum pressure built up in the cylinders.

Expect the readings to be lower at altitude than at sea level. Normally, I'd expect to see readings somewhere between 120 and 160 psi at sea level, but the number will vary, determined by your car's compression ratio and camshaft timing. Depending on the altitude, the barometer reading on any given day and how robust your battery is, the actual readings you get on a compression test can vary 10 to 15 percent up or down. What's far more important

is the consistency between the cylinders. If they're all a few pounds low, it might be that your battery is just a little discharged, or the barometer is low, or the throttle valve isn't propped open far enough while cranking the engine. If only one is weak, the condition might be indicative of a burned valve, leaky ring or scored cylinder wall. If two adjacent cylinders are very low, I immediately suspect a blown head gasket between them.

Counterintuitively, high-performance engines often show lower compression readings because the hot camshafts leave the valves open well past bottom dead center, lowering the effective compression ratio.

A number of late-model cars can replicate a compression test without removing the spark plugs. Under the



NOW YOU KNOW

Check Your CV Boots

Constant-velocity (CV) joints, the articulated joints that carry power from the differential to the wheels of cars with independent suspensions, generally last a good long time. The mechanical parts are bathed in a generous handful of special grease doped with a high concentration of molybdenum disulfide, a powdered extreme-pressure lubricant. As long as these parts continue to marinate in this concoction, they'll last the life of the car.

Unfortunately, the rubber boots that keep the grease in and the dirt and water out are fragile. It's a good idea to take a minute or two every month or so, or at least every oil change, to inspect the boots for failure. If one splits open, it's only an hour of labor to remove the axle and clean and relube the joint with fresh grease. Yes, they do make split boots you can install without removing the whole axle from the car. But I've never been satisfied with

how clean you can get the inside of the joint while it's still on the car. Any dirt left inside is just going to grind at the metal parts. Better you should remove the axle, clean it up properly and reinstall with a fresh one-piece boot. Better yet, check the price of a remanufactured axle assembly, which for many cars is under \$100. With boots (times two) costing \$20 to \$30, you may as well hang a complete, clean, prelubricated axle, because the labor involved is the same.

command of a technician armed with a scan tool, the computer disables the cylinders one at a time in some sort of random sequence. After a few minutes, it will return a "Cylinder Balance" result. The cylinder(s) with low compression will affect idle speed less than the others when switched off, pinpointing any problems. I still like to do a compression test or leak-down test, because it gives me a chance to look at the plugs.

Locked Out

I own a 1969 Ford with a 428 Cobra Jet engine and the car constantly stalls. It has a mechanical fuel pump and "hard" fuel lines from the pump to the carb. I checked the fuel pump pressure and it reads 7 pounds. The car drives anywhere from 1 mile to 20 miles before it stalls. My next fix is to replace the fuel pump, but I am wondering if the car is suffering from vapor lock. It is a big block with long tube headers, so it certainly gets hot under the hood. The fuel line does not touch the block or manifold at any point. The car had a rubber fuel line from the pump to the carb when I purchased it, but it was not installed any farther away from the block or manifold than the hard line. If it is vapor lock, would changing back to a rubber fuel line solve the problem?

I agree, it's probably vapor lock, caused by liquid fuel boiling in the carb or fuel lines, preventing sufficient liquid fuel from reaching the jets. The vapor pressure of gasoline is much higher than it was in 1969, since we use a lot more of the crude oil in the barrel, including a higher percentage of more volatile fractions that used to be flared off. And it's those fractions that boil at lower temperatures than the rest of the fuel. Fortunately, fuel-injected cars aren't prone to vapor lock because the fuel in the engine compartment is usually between 30 and 60 psi, not the seven or less used by carbureted vehicles.

Changing back to a rubber line and moving it away from the headers might help reduce the temperature of the fuel inside the lines. Just insulating the hard line might be enough to prevent boiling. The fuel is probably actually boiling in the float bowl, however, not in the line. They make insulated base gaskets for

WeatherTech®

Automotive Accessories

Ford Focus



FloorLiner™ is made from a Sturdy High-Density Tri-Extruded Material, and is Laser Measured to Perfectly Fit Your Vehicle! Available for Popular Cars, Trucks, SUVs and Minivans in Black, Tan or Gray.

©2009 MacNeil Automotive Products Limited

They just snap right in!



Chrysler Town & Country

Toyota Highlander



Cargo-Trunk Liner Computer Designed Protection for Cars, SUVs and Minivans. Available in Black, Tan or Gray.

Side Window Deflectors for Virtually Any Car, Pickup, SUV or Minivan! No Exterior Tape Needed. Also Available in Dark Tint.



Chevy Impala

All-Weather Floor Mats for Virtually Any Car, Pickup, SUV or Minivan! Available in Black, Tan or Gray.

See and Order Everything at
WeatherTech.com
800-441-6287

MacNeil
AUTOMOTIVE
PRODUCTS LIMITED
Specialists in Original Equipment and
Aftermarket Automotive Accessories



2435 Wisconsin Street
Downers Grove, IL 60515
630-769-1500 • fax 630-769-0300



Canada Customers;
www.weathertech.ca

When was the last time you filled up?

Gas goes bad in as little as 30 days.



Same great product,
now with more
corrosion protection!

Use new, improved STA-BIL Fuel Stabilizer **AT EVERY FILL UP** to:

- Protect against corrosion caused by today's Ethanol fuels
- Prevent formation of gum and varnish build up
- Improve performance and reduce starting problems

When you store, start with STA-BIL®

©2009 Gold Eagle Co. www.sta-bil.com

Lubriplate®

No. 105 Motor Assembly Grease



Contains Zinc-Oxide Anti-Wear Additive.

*The Original Pre-lube for Installed Engine Parts.
Provides Lubrication During Initial Start Up.
Prevents Scuffing, Scoring and Damage.*

Also Try These Other High Quality Lubriplate® Lubricants.



Now Available Online at...

Lubriplate.com

Or Call 1-800-733-4755

Also Available At:



1-800-492-PART
for store locations

PM DIY AUTO /// CAR CLINIC Q+A

those carbs, and some cars with carbs used sheet-metal heat shields to keep heat from the headers from radiating into the carburetor.

Toward the end of the carburetor era in the '80s, some manufacturers resorted to recycling some of the fuel from the fuel pump back to the tank. This was done with a tee fitting that had a small restriction in one leg of the tee, allowing a small trickle of fuel to go back to the tank through a separate line. The cool fuel from the tank, moving continuously through the line, kept the fuel from boiling. This required a fuel tank with an additional fitting for the return line. You might check if your tank could be modified, or replaced with a later model tank with the fitting. Come to think of it, the fitting was often in the fuel sender plate, so all you might have to change is the fuel sender for one with the extra fitting, and then run an additional line from the engine compartment back to the tank.

If you have air conditioning, you might try my favorite fix: Wrap the fuel line around the cold a/c refrigerant line as the refrigerant line heads back to the compressor from the evaporator. Strip off the insulation, wrap the hose around the cool line, and rewrap with fresh insulation. I'll bet that if the engine is hot enough to vapor lock, you're hot enough to need the air conditioning on.

Hot Problem

I have a 2007 Hyundai Azera. The dealer replaced the battery last spring, and it's already dead. Also, the dealer says that batteries don't really last in Florida. Even if that's true, a year or less seems like an awfully short life span for a battery.

I'm going to assume the dealer has checked out your charging system and given it a clean bill of health. As far as his assertion that batteries don't last in Florida, he's sort of right. The thing that kills batteries is heat, because it boils off the water in the electrolyte and hastens the sulfation process. That's when some of the lead on the plates of a partially discharged battery oxidizes into lead

sulfate. The lead sulfate interferes with the normal charge-discharge chemistry of the battery, reducing capacity until finally you can't start your car.

Although most of the damage is done in the summer, the batteries customarily fail in colder weather. That's because cold oil is thicker than warm oil, and therefore demands more from the starter motor. Similarly, your car's electrical demands are higher in winter because you're running lights and window defrosters and windshield wipers more frequently. But: One year is still abnormally short. I'd be expecting at least a partial warranty.

Here are my suggestions to make your next battery last longer:

Use a conventional battery, not a maintenance-free one. Periodically check the level of electrolyte and add distilled water as necessary. Maintenance-free batteries have no filler caps. They generally do have more standing electrolyte above the plates to compensate, but when they're in service a lot of water boils away, so they can't last as long as conventional batteries that can be topped off every few months.

Be sure the dealer has reinstalled any battery heat shields that the manufacturer installed at the factory, to keep the battery temperature down.

Avoid parking in the sun.

Be sure the car is driven regularly for enough distance to keep the battery charged. Vehicles with short driving cycles may very well not ever charge the battery completely, hastening its demise. If this is your problem, you may need to use a small battery maintainer plugged into the wall, or at least try to get out of the house more often.

Pairing Up

Do both wheel cylinders on the rear brakes of a car have to be replaced at the same time or can they be done one at a time? The car only has 54,000 miles.

Technically, there is no compelling reason to replace both wheel cylinders or both calipers at the same time. But economically, it probably does make

sense. Both sides have seen the same service, and the other one is likely near failure. You've already got the car up in the air, and are replacing the shoes or pads on both sides anyway. (Yes, you are. Never replace the pads or shoes except as a complete set.) And if you've got one side of the hydraulic system open, you have to bleed the whole thing anyway. The incremental cost to replace a wheel cylinder is not large. The only reason I'd skimp is if it meant waiting around for parts while I was on vacation or something.

Blowing Hot and Cold

I have a 1995 Buick Park Avenue and I am having problems with the heating system inside the car. I get heat only from the driver's side—the passenger side blows only cold air. The problem occurs with the floor, mid and windshield vents, and I do not understand why the driver's side is working and the passenger's is not.

Split HVAC controls were available on your car, allowing the driver and passenger to control the temperature in their seats individually. I'm assuming your vehicle has this system, rather than the standard automatic temperature controls. There are a couple of extra air doors, actuators and linkages for this climate-control system. Your problem is fairly common in GM vehicles of this vintage, and it's usually a vacuum leak internally in the programmer that routes vacuum to all those air-blend doors. It's not a cheap part. My suggestion is to have your mechanic lock open the air-blend doors that control the passenger side, disconnect their vacuum lines, and give up the dual-control option.

Bad Vibes

I recently read an article from an old PM with instructions detailing how to clean the throttle body in a car. I just purchased a 1999 Saturn SC1, and the little car runs great—except when it's not moving. It really vibrates while sitting in park or at a stop sign. In fact, it vibrates so hard it is virtually impossible to see clearly in the rearview or side mirrors. I think it just needs some TLC and the aforementioned cleaning of the throttle body.

However, a few of my friends say this is a normal condition for a Saturn, that they all do it, even when they are new. Are they pulling my leg? Or should I just go ahead and clean the throttle body whether it needs the work or not?

Well, first-generation Saturns have never been known for good NVH (noise vibration and harshness) quotients, but the ones I've driven over the years haven't been that bad. Have the shop check the engine idle speed, which should be pretty near 700 rpm. If the idle is low, you'll notice more idle shake. Tampering with the factory-adjusted idle screw isn't permitted by the service manual, for reasons GM doesn't specify but that probably have to do with emissions requirements. You'll need to check for a metered-air leak, a sticky throttle blade, a sticky idle air controller, a leaky EGR valve and a half-dozen other things. Cleaning the throttle body *might* help, but you should at least try to figure out what the problem is first.

But wait, there's more! There's a service bulletin out on your car for the

upper front engine mount. Check the mount: If the rubber is solid, it's the old style and needs to be replaced with the newer style. The newer style has a 2-millimeter horizontal slot to make it more compliant. If the slot is narrower than 2 mm, the mount has collapsed and needs to be replaced.

Another tactic I've used on cars with lots of idle shake is to loosen up all the bolts on the engine mounts. Then start the engine, and—with your foot on the brake—put the transmission alternatively in drive and reverse a few times. Back to neutral, shut off the engine and tighten everything up. This should realign the engine mounts, and maybe lessen the shake. **PM**

Got a car problem?

Ask Mike about it. Send your questions to pmautoclinic@hearst.com or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



Families Have Saved Up To 50% On Heating Costs

And never have to buy fuel — oil, gas, kerosene, wood — ever again!



Lifetime Warranty

Hydro-Sil is a high performance individual room heating system that can save you hundreds of dollars in home heating costs by replacing old and inefficient heating. It can replace or supplement your electric heat, gas or oil furnace and woodstoves.

Hydro-Sil represents economy in heating: inside the heater is a sealed copper chamber filled with a harmless silicone fluid designed for heat retention qualities. The fluid is quickly heated by a varying amount of micro-managed proportional power. This exclusive technology greatly increases energy savings.

Check ■ MasterCard ■ Visa ■ Discover

1-800-627-9276

www.hydrosil.com

Hydro-Sil, P.O. Box 662, Fort Mill, SC 29715

Your Benefits with Hydro-Sil:

- Slash heating cost with Hydro-Sil
- Furnace free — duct free
- Lifetime warranty. No service contracts
- Safe, complete peace of mind
- Clean, no fumes, environmentally safe
- U.L. listed
- Preassembled — ready to use
- Portable (110V) or permanent (220V)
- Whole house heating or single room

Contact us today for info and FREE catalog!

220 VOLT PERMANENT	Approx. Area to Heat	S&H	Discount Price	Qty.
8' 2000 w	250-300 sf	\$25	\$319	
6' 1500 w	180-250 sf	\$25	\$289	
5' 1250 w	130-180 sf	\$25	\$259	
4' 1000 w	100-130 sf	\$18	\$239	
3' 750 w	75-100 sf	\$18	\$189	
2' 500 w	50-75 sf	\$18	\$169	
Thermostats — Call for options & exact heater needed.				
110 VOLT PORTABLES (Thermostat included.)		S&H	Discount Price	Qty.
5' Hydro-Max 750-1500 w		\$25	\$229	
3' 750 w — Silicone		\$18	\$179	
Heavy-Duty 240v		\$25	\$329	
Total Amount				

Name _____
 Address _____
 City _____ St. _____
 Zip _____ Phone _____
 MasterCard, Visa or Discover Account Information:
 Acct # _____
 Expiration Date _____



Tech

diy

The DIY Touchscreen PC

TABLET PCS MAY BE THE NEXT BIG THING IN COMPUTERS. HERE'S HOW TO MAKE YOUR OWN TOUCHSCREEN PC, STARTING WITH AN OFF-THE-SHELF NETBOOK. *BY ANTHONY VERDUCCI*

→ By outfitting an off-the-shelf netbook with a touchscreen, we were able to make our own finger-friendly PC.

→ If the buzz is to be believed, 2010 will be the year of the touchscreen tablet PC, with multiple major manufacturers lining up products that they claim will give us a carry-anywhere way to read e-books, watch movies and surf the Web.

And while I suppose I could just buy one of these machines, I thought it'd be more fun to make my own touchscreen PC out of last year's "it" computer: the lowly netbook. The advantage: Unlike these new tablets, my creation would also have a keyboard, making it far more practical for typing-heavy tasks like e-mail and running Word. The project's total cost: less

INSIDE

x

SILICA GEL + SMARTPHONE BATTERY LIFE + SYNCING BLACKBERRIES

INSTALLING THE TOUCHSCREEN



1. Cover touchscreen with protective film.

2. Disassemble computer.

3. Wire USB power hub controller into the computer and the new touchscreen.

4. Place the touchscreen panel over the existing LCD.



than \$500, including the computer.

First, I needed to gear up. I bought a Lenovo IdeaPad S10-2 netbook (retail price: \$350) and a Hoda Technology Solderless Touch Screen Kit (\$96 from fidohub.com), which contained everything I'd need to transform a netbook into a touch-friendly tablet. Hoda offers a variety of models that are designed to fit specific netbooks, so make sure you get the right one if you try this at home.

I wanted to be sure the new touchscreen was properly protected, so I purchased a BodyGuardz transparent scratch-proof skin, which is designed to protect touchscreens without impairing their sensitivity. Before covering the new panel, I gave it a once-over with a can of compressed air—otherwise, dirt and dust could be forever trapped under the BodyGuardz.

Taking the PC Apart

➔ **Next came the fun part.** In order to wire in the new screen, I first needed to disassemble much of the netbook. I

started with the easy stuff: I removed the battery, unscrewed the underbelly screws and took out the hard drive. Removing the keyboard and screen bezel was a bit trickier—they had to be pried off with a filed-down plastic knife (plastic is less likely to scratch than metal). If you decide to take on this project, open the screen and look for a seam that runs along the side, around the entire machine, either just above or just below the USB slots. Using the knife (or a similar tool), gently pry into this seam until the case begins to separate. With the underbelly screws removed, this should be very easy. To take apart the screen bezel, look for a similar seam along the side of the display, and use the knife to pry it apart as well. The bezel should pop right off.

Of course, the new touchscreen needed to get its power from somewhere. The kit comes with an internal USB power control hub—basically a USB hub that is installed inside the computer. This hub needs to be

crammed inside the machine, which can be tricky with a cramped netbook (mine fit just above the computer's Wi-Fi card). From there, it feeds power from the motherboard to the screen. After the hub is hooked up, it will actually have two unused internal USB cords.

These are free to deliver power to components. I took one and attached a Kensington Bluetooth USB Micro Adaptor (one of the smallest Bluetooth dongles on the market), giving my netbook the ability to wirelessly communicate with a Bluetooth keyboard, mouse or phone.

Placing the Panel

➔ **Now it was time** to attach the touchscreen panel. The new screen has to be placed on top of the old one with perfect alignment.

To do this, I put the battery back in the computer and turned the screen on, allowing me to see the LCD's exact borders. One side of the new touch panel comes coated with adhesive, so I pressed this side into place over the lit-up screen. After I restarted the computer, the touchscreen was working—and I was able to accurately control the cursor with my finger. But it's smart to give it a test run before you put the computer back together—just to be sure everything is in place.

While the laptop was open, I thought it couldn't hurt to add some upgrades—more RAM and a faster and higher capacity storage drive will help a previously sluggish netbook stave off obsolescence, at least for a little while. I upgraded my machine to 2 GB of DDR2 SDRAM and a solid-state storage drive. I was now done and ready to put it all back together again—a fairly straightforward procedure. The final product: a powerful, portable, touch-friendly computer. Did it let me do anything a normal PC couldn't do? Not really, although that could soon change, now that developers have the ability to build touch capabilities directly into Windows 7 applications. But it did let me move away from the netbook's cramped touchpad and keyboard and spread my hands over a spacious touchscreen. And it certainly draws stares when I pull it out at a Starbucks.

PM

Digital Clinic

by Seth Porges

Q+A



Some Uses for Silica Gel Packets



Underwater Photography

Slip a packet into an underwater camera casing to counter condensation.



For Travel Gadgets

Stash a packet or two in a zipper bag with your travel gadgets to fight stray moisture.



Saving Wet Phones

Submerge a wet phone in a bowl of silica gel packets overnight.

The Many Uses of Silica Gel

Q I've lost a number of gadgets to water damage. Do you have any tips for safeguarding electronics from moisture?

A As long as electronics have been around, they've been locked in a struggle against water. Those wet bundles of hydrogen and oxygen have the ability to fog lenses, short out electrical circuits and otherwise prematurely end our gadgets' lives.

One of my favorite weapons in this war: the common silica gel packet. When these unassuming little pouches of desiccant beads—easily identifiable by their iconic warning, “Do Not Eat”—find themselves in an enclosed environment with moisture, they suck it up like miniature Shop-Vacs. Their hydrophilic nature allows them to be employed as a cheap and unobtrusive tool to keep packaged goods such as beef jerky, clothes and shoes dry; it

also makes them effective for keeping limited amounts of moisture away from electronic devices. When used creatively, silica gel can be a gear fiend's best friend.

Whenever I stumble across a packet, I stash it away for later. But if you want to jump-start your collection without buying several pairs of shoes, these packets can be purchased online at various sites for about 25 cents each—less if you buy in bulk.

One of my favorite uses: drying out accidentally dunked devices. The key is to recover the sunken gadget as soon as possible, remove the battery and submerge both in a bowl of silica gel packets overnight. The gel will suck up lingering moisture from within the gizmo, and it is both safer and more effective than turning a hair dryer on your phone, which can fry the circuits. (If you're short on silica, a bowl of dry rice will also work in a pinch for this purpose.)

Silica gel packets are also a must-have for underwater photographers or videographers who rely on submersible housings for their cameras. Stray specks of water can easily fog or streak the lenses of cameras and camcorders, ruining photographs. Because silica gel packets are small and flexible, they are easy to stuff inside the casing along with the camera, ensuring a dry and condensation-free environment.

The desiccant is also useful for gadget storage—either at home or on the road. When I travel, I usually pack most of my electronics and chargers into a zipper storage bag. Although the zipper seal usually does an adequate job protecting its contents from

a leaky toiletry bag or bottle that might be sharing the suitcase, tossing a few packets of silica gel in the bag acts as an extra insurance policy. And popping a packet or two into a sealed Tupperware container turns it into a perfect place to store a camera or GPS device when it isn't in use.

There are, no doubt, many other uses for silica gel's water-fighting abilities. If you've stumbled upon any particularly creative applications, drop me a line at pmdigitalclinic@hearst.com and I'll share them in a future Digital Clinic.

Better Battery

Which is worse for my smartphone's battery life: accessing the Internet over Wi-Fi or over the 3G network?

Definitely 3G. The iPhone 3GS, for example, gets a claimed battery life of 9 hours of Web-surfing over Wi-Fi, but just 5 hours using 3G. However, if battery life is an issue, both should be turned off when you aren't accessing the Web or using data-heavy apps—merely having the Wi-Fi or 3G networks turned on is enough to cut hours off your phone's battery life. That's why most new smartphones give you the ability to disable Wi-Fi and 3G—an option I find myself using frequently.

PM

Got a technology problem?

Ask **Seth** about it.

Send your questions to pmdigitalclinic@hearst.com or to Digital Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



Popular Mechanics (ISSN 0032-4558) is published 12 times a year by Hearst Communications, Inc., 300 West 57th Street, New York, NY 10019, U.S.A. Frank A. Bennack, President and Chief Executive Officer; Catherine A. Boston, Secretary; Ronald J. Doerfler, Senior Vice President, Chief Financial Officer and Treasurer; Hearst Magazines Division: Cathleen P. Black, President and Group Head; John P. Loughlin, Executive Vice President and General Manager; John A. Rohan, Jr., Vice President and Group Controller. © 2009 by Hearst Communications, Inc. All rights reserved. Popular Mechanics is a registered trademark of Hearst Communications, Inc. Periodicals postage paid at N.Y., N.Y., and additional entry post offices. Canada Post International Publications mail product (Canadian distribution) sales agreement no. 40012499. CANADA BN NBR 10231 0943 RT. POSTMASTER: Send address changes to Popular Mechanics, P.O. Box 7186, Red Oak, IA 51591. Printed in U.S.A.

EDITORIAL AND ADVERTISING OFFICES:
300 West 57th Street,
New York, NY 10019-5797.

SUBSCRIPTION SERVICES:
Popular Mechanics will, upon receipt of a complete subscription order, undertake fulfillment of that order so as to provide the first copy for delivery by the Postal Service or alternate carrier within 4–6 weeks.

>>> Subscription prices: United States and possessions: \$24.00 - for one year; Canada and all other countries: \$40.00 - for one year.

>>> Should you have any problem with your subscription, please visit service.popularmechanics.com or write to Customer Service

Department, Popular Mechanics, P.O. Box 7186, Red Oak, IA 51591. Please enclose your mailing label when writing to us or renewing your subscription.

>>> Popular Mechanics is not responsible for unsolicited manuscripts or art. None will be returned unless accompanied by a self-addressed stamped envelope.

MAILING LISTS:

From time to time we make our subscriber list available to companies who sell goods and services by mail that we believe would interest our readers. If you would rather not receive such mailings, please send your current mailing label or exact copy to: Popular Mechanics, Mail Preference Service, P.O. Box 7024, Red Oak, IA 51591-0024.

AS A SERVICE TO READERS,

Popular Mechanics publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from information published in this magazine.

FREE

Audio/Video Catalog



Count on Crutchfield for the latest in top brand A/V gear.

- One-on-one expert help to find the right gear for you
- Free shipping on most orders



Call for your free catalog today

1-800-317-9722

or www.crutchfield.com/mechanic

CRUTCHFIELD

Deadly Season

(CONTINUED FROM PAGE 71)

patroller thought a bomb's fuse had gone out and was attempting a relight when it exploded. Now, every bomb in Big Sky is threaded with two fuses, and is set off by yanking pull-tab igniters.

"Just one mistake on this job can kill you," says Bob Dixon, director of the Big Sky patrol, which includes 8 women, 50 men and a half-dozen dogs, including two Australian shepherds and a chocolate Lab named Mowgli. "But no matter how careful

ONE MISTAKE CAN KILL YOU. BUT NO MATTER HOW CAREFUL YOU ARE, [IT'S] UNPREDICTABLE. AVALANCHE CONTROL IS 30 PERCENT SCIENCE, 50 PERCENT ART AND 20 PERCENT LUCK.

you are, you always deal with the unpredictable. Avalanche control is 30 percent science, 50 percent art and 20 percent luck."

Researchers are hoping to shift these percentages in science's favor. The world's major avalanche-study centers are widely scattered—in Davos, Switzerland; in Nagaoka, Japan; and just an hour up the road from Big Sky, at Montana State University in Bozeman. Last October, under the direction of engineering mechanics professor Ed Adams and another faculty member, Montana State opened its Cold Climate Simulation Chamber, a room in which the ceiling is chilled to minus 58 F and an artificial sun shines on a one-square-meter slope. The goal is to home in on the conditions that create the strongest and weakest bonds between layers of snow. "There's a mystique that it's difficult to accurately predict avalanches," Adams tells me when I visit the lab. "But snow is just a material—though it is a very complicated one."

Along with a company called ThermoAnalytics and experts at the Swiss Federal Institute for Snow and Avalanche Research in Davos, Adams has developed software packages that promise to boost the accuracy of avalanche forecasts. But for now, away from the laboratory, the work is still a mix of science and instinct that entails long hours—the first patrolers arrive at Big Sky before 4:30 am—

and lots of explosives.

By the time the mist settles from the first bomb Ross and Steve set, they've already skied to the next slide path. Here, Steve hangs a bomb from the limb of a dead tree. It's a tricky work environment: Howling wind hampers voice communication, dense fog has eliminated most visibility, the slope they're standing on could slide at any moment, and of course they are handling deadly explosives. "Our lives are literally in each other's hands," Ross says, brushing off the icicles that have taken root in his reddish-blond beard.

BOB DIXON, BIG SKY
SKI PATROL DIRECTOR

Ross grew up in the mountains of New Hampshire but fell in love with the Rockies. "I became a patroller," he says, "after I failed college philosophy because I'd spent too much time on the ski hill." He and Steve work with a practiced synchronicity and few words—hand gestures, clipped phrases—as they set off bombs in slide areas. Avalanches tumble; the smell of sulfur hangs in the air; a spray of black powdery residue stains the snow.

Across the resort, 13 more teams are working to clear their own patches of turf. Explosions blast and echo across the cliff faces. The patrollers use three types of explosives. Ross and Steve are using cast primers. Gel shots, which are fat sticks of dynamite, are less powerful but have other advantages—for one, they do not leave black-powder remains and thus are better for south-facing slopes, where powder heated by direct sunlight could create large melt areas. ANFO, ammonium nitrate fuel oil, essentially a large bag of fertilizer, can be detonated with either of the other two.

Big Sky also uses two Buck Rogers-looking cannons, called Avalaunchers, which are powered by nitrogen gas that propels cast primers—each fitted with a plastic nose cone, fins and a trigger that detonates on impact

only—high onto dangerous-to-reach cliff bands. As the early morning progresses, teams zip by on snowmobiles; one patroller, working out of a cramped communications center at the mountain's base, monitors everyone's position. And the resort is open to the public by 9:05 am.

Once the avalanche-control work is finished, many of the patrollers hang out in one of the lift-top huts, swapping stories, telling jokes and waiting for a call if medical help is needed. At one hut, Jay Frisque, better known as Magnum ("Because his patroller number is 44, and because he's a badass," Ross says), has cooked up antelope sausage burritos over a portable stove for a crowd of hungry patrollers. It's an addictive profession, Magnum says, grinning slyly—so long as you crave horrible weather, sweaty co-workers and a guarantee that you'll never be rich. "There isn't a person in this room," he adds, "that I wouldn't risk my life for. Or bail out of jail."

The day ends where it begins—in the patrol locker room. In a posh resort like Big Sky, the locker room is the equivalent of a teenager's back-of-the-garage hangout. Stickers are pasted everywhere. A couple of slices of old pizza are strewn on the floor. One ski, cracked in half and mounted on the wall, is signed by a patroller who got buried in an avalanche and was dug out by co-workers. There's also a ski from each of the two Big Sky patrollers who have died on the job.

I conduct a precise inventory of the locker-room's refrigerator: 216 cans of Pabst Blue Ribbon beer and nothing else—not so much as a packet of ketchup. (A patroller needs to bring a case of beer every time he or she commits what's known as an R.B.O.—a round-buying offense—which includes such infractions as getting your backpack stuck in the slats of a chairlift or taking a big fall in front of the public.)

Beers are distributed as the afternoon wanes, but no one pops the top, or starts to change out of uniform, until the last of the on-duty patrollers enter the locker room. That's a strict patroller tradition, I'm told. They won't even take their boots off until everyone is safely home.

PM

Forget saving the world. How about helping one kid one time with one donation?



Smile Train provides free cleft surgery which takes as little as 45 minutes and costs as little as \$250.

It gives desperate children not just a new smile—but a new life.

**“...one of the most
productive charities —
dollar for deed — in the world.”**
—*The New York Times*

Help children with clefts and other problems.

☐ \$250 Surgery. ☐ \$125 Half surgery. ☐ \$50 Medications. ☐ \$ _____

Mr./Mrs./Ms. _____ Zip _____

Address _____ City _____ State _____

Telephone _____ eMail _____

Credit Card # _____ Expires _____

☐ Visa ☐ MasterCard ☐ AMEX ☐ Discover Signature _____

☐ My check is enclosed. Z10011053ZFVY33

Smile Train, P.O. Box 96211, Washington, DC 20090-6211

Donate online: www.smiletrain.org or call: 800-932-9541



According to the U.S. Government, women who plan to have a child should be sure to take sufficient levels of folic acid (400 micrograms per day) during pregnancy to help prevent neural tube defects and reduce the risk for cleft lip and palate. When folic acid is taken one month before conception and throughout the first trimester, it has been proven to reduce the risk for neural tube defects by 50 to 70 per cent. Foods to avoid may include raw or undercooked seafood, beef, pork or poultry; delicatessen meats; fish that contain high levels of mercury; smoked seafood; fish exposed to industrial pollutants; raw shellfish or eggs; soft cheeses; unpasteurized milk; pâté; caffeine; alcohol; and unwashed vegetables. Smile Train is a 501 (c)(3) nonprofit recognized by the IRS, and all donations to Smile Train are tax-deductible in accordance with IRS regulations. © 2010 Smile Train.

BUYER'S GUIDE

For advertising rates call Angela Hronopoulos (212) 649-2930, fax: (646) 280-2930.



Get Light in Tight Spaces!

Powerful LED 12 Rare Earth Magnets Aim Light in Any Direction

MAGNETIC LIGHT MINE

704-658-9332  RadioShack

www.StrikerHandTools.com/mlne

SELF-FEEDING DR® CHIPPER!

SELF-FEEDING

saves time and energy. Most branches will self-feed, instead of having to force-feed them.

CHIP BRANCHES UP TO 5-1/2" thick with powerful engines up to 18 HP.

PRO-SPEC® KNIVES are similar in size and design to commercial chippers.

NEW 3-POINT HITCH MODELS, TOO!

Get a FREE DVD and Catalog

1-800-708-5173

www.DRchipper.com



Great Investment



Maintenance-Free • Savings Up to 60%
High Quality American Steel Span buildings make a great investment, perfect for workshops, ideal for garages.

www.steelspan.com

800-891-6733 ext 036

©2008 King Solomon Creative Enterprises Corp.



FIVE MINUTE FENCE STAIN

Stain 100 feet of fence in just 5 minutes! Sprayer attaches directly to garden hose. No masking, simply hose off over-spray. One quart covers 600 square feet. Select from three natural wood tones; Natural Cedar, Dark Cedar or Redwood.

www.FiveMinuteFence.com



TerraTrike
RIDE IN COMFORT

World's Most Comfortable Ride

WWW.TERRATRIKE.COM
FREE CATALOG 800-945-9910



Best Parts. Best Prices. Period.

- PICKUP REPAIR PANELS
- CARPET/VINYL
- Zero-RUST™ paint & more

RAYBUCK
AUTO BODY PARTS
raybuck.com PH: 800-334-0230



**- Human Growth -
- Hormone -
- Testosterone -**

Legal & Safe

**No Prescription Needed
Order Online**

www.Phd10.com

call 1-800-914-6559
- for Brochure -

Metal Spiral



Spiral Stair Kits

Add beauty & space saving functionality to any room.

Oak Spiral



You'll find the spiral stair kit that's right for your home.

Victorian One Spiral



THE IRON SHOP®

The Leading Manufacturer of Spiral Stair Kits®

Call for the **FREE** color Catalog
1-800-523-7427 Ask for Ext. PM
or visit our Web Site at
www.TheIronShop.com/PM

High Caliber Buildings.

High Caliber Performance.



When your building is working properly, everything else just falls into place. **Call Heritage today** for your high performance metal building.

HERITAGE
BUILDING SYSTEMS.
Established 1979

1.800.643.5555 | HeritageBuildings.com

FISH ANYWHERE

with this **AMAZING 42 lb. FISHING MACHINE!**

NEW
Sea Eagle 285 FPB
Go where others
only dream about -
Ponds, Lakes, Rivers,
Inland Bays

Unique
FrameLess
Design



- 9' long & 4' wide • Super-Tough Hull Material
- Holds 1 Adult / 450 lbs. • Takes up to 3 HP
- 4 Minute Setup • Fits in car trunk
- Safe & Stable



Carry in your car trunk
and be ready to fish in just four minutes!
The Sea Eagle 285 FPB features a full fabric floor,
a pouch stow bag, 2 rod-holders, foot pump, 2 oars,
motormount, floorboard, swivel seat & carry bag.

**WINTER SPECIAL: Just \$699. for all
of the above & FREE SHIPPING.**
See more at www.SeaEagle.com

Call **800-944-7496**
for **FREE** Color Catalog, DVD & Material Sample:

SEA EAGLE.com Dept. PM010B

Suite 1, 19 N. Columbia Street, Port Jefferson, NY 11777

GREAT SPACE ADDITIONS FOR EVERY BACKYARD AND GARDEN

Incredible Do-it-Yourself Buildings
at Amazing Do-it-Yourself Prices!



**SAVE UP TO
45%
ON SELECT MODELS**

FUTURE STEEL BUILDINGS Call for your **FREE** Brochure
www.FutureSteel.com **1-800-668-5111** ext. 1530

Fasten wiring WHEREVER you need to!

No need for mechanical fasteners like
clips, clamps or screws. **Simply Peel-n-Stick!**



Wirestrap Sticks To:

Most Household & Industrial Surfaces

- Metals - Bare, Painted & Powder-Coated
- Plastics - Polyethylene, PVC, ABS, Etc.
- Glass, Tile, Laminates, Composites
- Wood - Finished & Unfinished

3M 300MP High-Performance
Acrylic Tape

US Patents: 5,827,588 & 5,531,330
Made in the USA

wirestrap
peel-n-stick wire fastener

Toll Free: (866) 677-6665 or Visit:
www.wirestrap.com

POPULAR MECHANICS
2009 BREAKTHROUGH
AWARD WINNER



INTRODUCING
THE WORLD'S FIRST
**ALL-ELECTRIC ZERO-TURN
RIDING MOWER**

ZEON

JUST UNPLUG AND MOW



hustlerturf.com/zeon

VIAGRA[®]
Cialis[®] LEVITRA[®]

Propecia, Valtrex, Xenical and more...

FREE SHIPPING COUPON CODE **POPMECH09**

OVER 1.5 MILLION ORDERS PROCESSED
CELEBRATING
**10
YEARS**
OVER 1.5 MILLION ORDERS PROCESSED

VIAMEDIC[®]
SAFE • SECURE • DISCREET

ORDER NOW! Se habla español

WWW.VIAMEDIC.COM
800-547-9903

Coupon Expires 12/31/09

MDMShelters.com **RHINO
SHELTER**

Protection
Industrial Grade **By Rhino Shelter**

10oz Fabric
Black Inner Surtin
UV-Treated
Rip-Stop

\$49900*
12 x 20 x 8
House & Round

\$31800*
Cycle Enclosure

\$179900*
22 x 24 x 12
Two-Car

\$89900*
14 x 24 x 10
Boat/SUV

\$119900*
14 x 30 x 12
Utility

\$269900*
30 x 30 x 15
Three-Car

Easy Assembly
plus SHN

Visit our new site
www.RhinoShelters.com
Easy Assembly
plus SHN

CALL NOW!
1-800-447-7079

7 DAYS A WEEK • DEALER INQUIRIES WELCOME

MATHTUTORDVD.com
Press Play For Success

**Having Math Problems?
WE CAN HELP!**

SUBJECTS:

- BASIC MATH
- BASIC MATH WORD PROBLEMS
- PRE-ALGEBRA
- ALGEBRA 1 & 2
- ALGEBRA WORD PROBLEMS
- ADVANCED ALGEBRA
- GEOMETRY
- TRIG/PRECALCULUS
- CALCULUS 1, 2, 3
- PHYSICS

**AVERAGE COURSE
LENGTH: 8 HOURS**
**MOST COURSES COST
ONLY \$26.99**

Subjects Coming Soon: Matrix
Algebra, Unit Conversions, and
Probability/Statistics.

**VISIT OUR WEBSITE
TO VIEW SAMPLE
VIDEO CLIPS OF
EVERY COURSE**

**#1 Rated Math &
Physics Tutorial DVDs**

All topics taught entirely through
worked example problems.

Raise grades or your money back
877-MATH-DVD

Visit: MathTutorDVD.com/pm

CLASSIFIED ADS

To reach over 9 million prospects, or for additional advertising information, call Kathleen Gleason at 888-473-0788, or e-mail: klassmark@aol.com. Thank you for choosing Popular Mechanics Classified Advertising, 512 West Burlington Ave., LaGrange IL 60525. For subscription questions, visit service.popularmechanics.com.

ALTERNATIVE ENERGY

DISASTER PROOF YOUR HOME.

Scientist reveals methods he uses to produce homemade energy. Get everything you need to build solar and wind power generators at your local hardware store...cheap and completed in one day. **FREE REPORT** at www.makefreepowernow.com

ALTERNATIVE TRANSPORTATION

Electric and Gas Powered Bicycles, Bike Conversion Kits, Scooters, Minibikes, Mopeds, Dirtbikes, ATVs, WWW.FIVEFLAGSMOTORBIKES.COM, (850) 941-2080

APPAREL

SUSPENDERS WITH PATENTED No-Slip Clip. Free Catalog 800-700-4515. www.suspenders.com

ARTS, CRAFTS, SUPPLIES

WHOLESALE PRICES ON JEWELRY CRAFT ITEMS, Beads & Beading Supplies, Rockhound Supplies, Belt Buckles, Clock Movements. Free 122 page catalog. **Eloxite:** Dept. 45, Box 729, Wheatland, WY 82201, Ph.: 307-322-3050 **Web:** www.eloxite.com

AUTOMOTIVE

AMSOIL, SYNTHETIC LUBRICANTS. Buy Direct, Register to Buy Wholesale. **Free Catalog.** 1-919-269-3331. www.synthoils.com

DVELUPS HEADLIGHT

RESTORATION KIT is revolutionizing the market. Restore cloudy, foggy, headlights, improve night vision plus restore factory sealer in 5 easy steps. Includes maintenance application. www.dvelop.com contact us at 863-965-0612 or 1-888-350-2932.

BICYCLES

GOLDEN EAGLE BICYCLE ENGINES 2 & 4 Cycle Geared Belt 25 - 40cc 517-410-2793 bikeengines.com

BOATS, OUTBOARDS, TRAILERS

BUILD A BOAT - Using full size patterns, 7' to 55', send \$9.95 for **NEW Catalog and Free Plans.** Glen-L, 9152 Rosecrans/PM. Bellflower, CA 90706. 888-700-5007. WWW.GLENL.COM/OFFER9 **BOAT KITS - PLANS - PATTERNS - SUPPLIES** Catalog \$5.00, Clarkcraft, 16-6 Aqualane, Tonawanda, NY 14150. 716-873-2640. www.clarkcraft.com

BUSINESS OPPORTUNITIES

Make \$500 Weekly, E-Z Assembly work. **FREE Information,** Send SASE; JDK-P Box 635, Hopkins, MN 55343-0635

CONCRETE CHARLIE™ SAYS:

Claim your piece of the \$100 Billion waterproofing industry and become a foundation crack repair specialist. Most Complete Training in the Industry! Don't Wait! Territories available NOW! Or, buy a kit and fix **your** cracks! www.concretecharlie.com Enter Pop. March Promo Code: 971208

\$1,000's WEEKLY mailing burglar alarm advertisements! Free supplies/postage! S.A.S.E.: RBM-P, Box 759, Lake Zurich, Illinois 60047-0759.

DO-IT-YOURSELF

HYDRAULIC JACK REPAIR

Manual and catalog: \$15.00 620-594-2247, Hydraulic Parts Supply, P.O. BOX 97-PM, Sawyer, KS 67134.

What happened to the sidewalk "It's sinking" fix it with www.DIY-SlabJack.com 877-785-7223.

EDUCATION & INSTRUCTION

SOON THE GOVERNMENT

will enforce the **MARK OF THE BEAST** as **CHURCH AND STATE** unite! Let **THE BIBLE** identify him.

FREE BOOKS/DVDs

The Bible Says, P.O.B. 99, Lenoir City, TN 37771 thebiblesaystruth@yahoo.com 1-888-211-1715

EDUCATION & INSTRUCTION

PUT YOURSELF INTO THE WORKFORCE WITH AN ACCREDITED HIGH SCHOOL DIPLOMA Adult Basic Education (ABE) Performance-Based Extended High School Completion (HSC) For Adults 16 and Older Career & Education Opportunities www.northwestschoolsuccess.com Call Today 1-866-657-4001 Or Email Us At: NWSOS@COMCAST.NET

Wrap your hands around a new career

Guitar design, repair and tech support is an exciting, growing field. Design and build your own instruments in state-of-the-art manufacturing facilities. Learn from renowned master craftsmen in the heart of the music industry. Shape your future at MI's Guitar Craft Academy. Call 1-800-255-7529 to join our next open house and experience MI's world-renowned hands-on education for yourself. **GuitarCraftAcademy at MI** guitarcraft.mi.edu

ELECTRONICS

CONDUCTIVE PAINT, EPOXY

From \$12. Silver or carbon paint. Silver epoxy. Carbon tapes. Custom formulas available. www.semsupplies.com 301-975-9798 (M-F).

Digital Copyguard Eliminator, Stabilize and Restore Distorted Video. Guaranteed to work with all DVD and VHS Systems. Free information Package 574-233-3053. www.rcdst.com

EMPLOYMENT

LOCAL DRIVERS NEEDED!

For drive-by property surveys www.drivedollars.com 800-322-6169, Extension 1787.

FINANCIAL

RARE COIN INVESTMENTS.

Our clients **DON'T LOSE** money! **FREE** brochure. **DENKO** 1-877-777-1754.

FOR INVENTORS

PATENT YOUR BRILLIANT INVENTION!!!

Registered Patent Attorneys
Available to Assist You

New York and New Jersey Offices
Call (646) 373-2504 or Email:

INFO@PATENTANDTAXLAW.COM

DEAL DIRECTLY WITH REGISTERED

PATENT AGENT and qualified US
Patent Office Examiner

**Don't be fooled by phonies,
Free patent information –**

"Patent, Develop, Market Your Invention".

Richard L. Miller 631-499-4343,

1-800-242-9853,

<http://www.pto-ag.com>

HEARING AIDS

HEARING AIDS - GUARANTEED

LOWEST PRICES! No huge commissions.

Home trial, terms. All makes.

We're the oldest, biggest, best.

Custom instrument specialists.

Free Information, 1-800-323-4212.

Lloyds-PMC

FREE HEARING AID CATALOG.

**CUSTOM DIGITAL AND
PROGRAMMABLE.**

HUGE SAVINGS. 45 DAY TRIAL.

**BETTER HEARING, PO BOX 219 DEPT
32, BROOKPORT, IL 62910.**

1-800-320-3300 Ext. 32

DIGITAL HEARING AID SALE

16 channel bands, any size, any type or
BTE \$339.95

Options: touchtone, twin mics,
custom molded - \$50.00

**New! Open Fit Technology -
most brands - big discounts**

Repairs \$77.00 (since 1981)

Free brochure & mold kit

Hearing One 1-800-249-4163

100 Main Street, Marty SD 57361

HELP WANTED

\$400 WEEKLY ASSEMBLING Electronic

Circuit Boards/Products. Rush S.A.S.E.:

Home Assembly - PM, P.O. Box 450,
New Britain, CT 06050-0450.

HOMEWORKERS NEEDED! Top pay for
assembling products. Rush S.A.S.E.:

HIS-PM, Box 5657, Clearwater, FL 33758.

INVENTORS

PROTECT YOUR IDEA!

Write Your Own Patent Application

PatentPro® Software

www.patentpro.us

INVENTORS

INVENTORS: Free information tells
how to offer your invention
for sale or license.

Kessler Corporation, 52+ years

800-537-1133, ext. 25,

www.kesslercorp.com

ATTENTION INVENTORS

Do you have a new product idea that
you would like to develop?

Check us out. Free information.

www.developYOURidea.com

LAKES & PONDS

LAKE OR POND? Aeration -

1st Step towards improved water quality.

Complete Systems \$169 - \$329

11,000 Gal. Per Hour Water

Fall Pump only 3.6 amps! Just \$399.95

www.fishpondaerator.com

608-254-2735 Ext. 3

LIVE STEAM MODELS

WORKING STEAM ENGINES!

Discounts! Accessories, Parts,
Stirling Engines.

Limited Edition Tin Toys, Cars & Trains.

Catalog \$6.95 Refundable.

Yesteryear Toys Dept. PMS Box 537

Alexandria Bay, NY 13607

www.yesteryeartoy.com

1-800-481-1353.

METALWORKING

BUILD, REPAIR, RESTORE ANY METAL

Quality Hand-tools & Forming Machines
for Automotive, Aviation, Homeshop,
Sculpture, Instructional DVDs & Workshops.

20 years & still the best!

Free catalog 530-292-3506

www.tinmantech.com

OF INTEREST TO ALL

FREE CATALOG by mail. Meet nice
singles. Photos. Profiles. All ages.

Since 1981. **www.nicesingles.com**

Call 931-879-4625.

OF INTEREST TO MEN

SINGLE RUSSIAN LADIES

Seek romance, marriage.

E-mail, tours, free ads for men.

Anastasia Intl. Since 1994.

HTTP://WWW.ANASTASIADATE.COM

ASIAN BRIDES! Worldwide!

Free Details/Photos!

PIC, Box 4601-PM, T.O., CA 91362.

805-492-8040. www.pacisl.com

OF INTEREST TO MEN

MEET LOCAL WOMEN

Listen & Reply to Ads **FREE!**

FREE code 7099, 18+

Call for local #. 1-888-634-2628

www.MegaMates.com

SECURITY

SPYBASE.COM

MYSPLYLINK.COM

What you don't know could hurt you.

Spy Gps/Cameras/keyloggers/Digital A/V
recorders. High end technology, low price.

Retail since 1989

1-800-570-5562 (CA)

SNOW GUARDS

STOP SNOW SLIDES ON

METAL ROOFS!

Practically Invisible, Easy Installation,
Online Estimator.

Fast Shipping **www.snojax.com**

SOFTWARE

**"AMAZING NUMBER DISTRIBUTION"
SOFTWARE.**

WWW.CONTEMPORARYBUSINESSGROUP.COM

STEEL BUILDINGS

OUTBACK STEEL BUILDINGS

A Different Kind of Steel Building!

Custom Homes, Barns,

Sheds, Garages, Commercial.

www.ameribuiltsteel.com 407-430-9401.

Dealer Opportunities Available.

TREASURE FINDERS

BURIED TREASURE – Sensitive

equipment allows locating from distance.

Brochure free. Simmons, Box 10057-MA,

Wilmington, NC 28404

www.simmonsscintificproducts.com

WANTED TO BUY

BUYING GOLD, SILVER,

PLATINUM - ANY FORM

60 years experience. Free pricing quotes.

Top payment. 1-800-932-1010

www.preciousmetalsreclaiming.com

WATER PURIFIERS

FREE Waterwisdom Report

Shocking truths revealed.

Which water is best for you?

1-800-874-9028 waterwise.com

WINE/BEER MAKING

WINEMAKERS - BEERMAKERS.

Free Catalog. (800)841-7404. Kraus,

7850-L, Independence, Missouri 64054.

www.eckraus.com/offers/L.asp



This Is My Job

*BLADESMITH

Name: BURT FOSTER
Location: BRISTOL, VA.
Age: 37
Years on Job: 8

1. PNEUMATIC HAMMER

Foster heats up carbon steel, then shapes it using this floor-mounted hammer. The head weighs 70 pounds and can strike three times per second. "I love forging by hand," Foster says, "but this hammer saves me a lot of wear on my elbows and shoulders."

2. HAMMER AND ANVIL

To forge blades by hand, Foster uses a 250-pound anvil and a 3-pound sledgehammer he bought more than a decade ago at Home Depot. "It's not a fancy European forging hammer," he says, "but I'm sticking with it, because it works."

3. HEAT-TREATING OVEN

Accurate to within 3 degrees Fahrenheit, this digitally controlled oven can maintain 1500 F—the temperature at which the carbon in the steel dissolves and is absorbed into iron. The blade is then rapidly cooled in water or oil, which changes the steel's molecular structure. Next, the metal is repeatedly heated and soaked, which makes it more resistant to breaking.

4. BELT GRINDER

Foster uses a KMG belt grinder with a 2-hp motor and a variable-speed drive to grind blades, shape handles and dress the edges of leather sheaths.

5. SANDPAPER

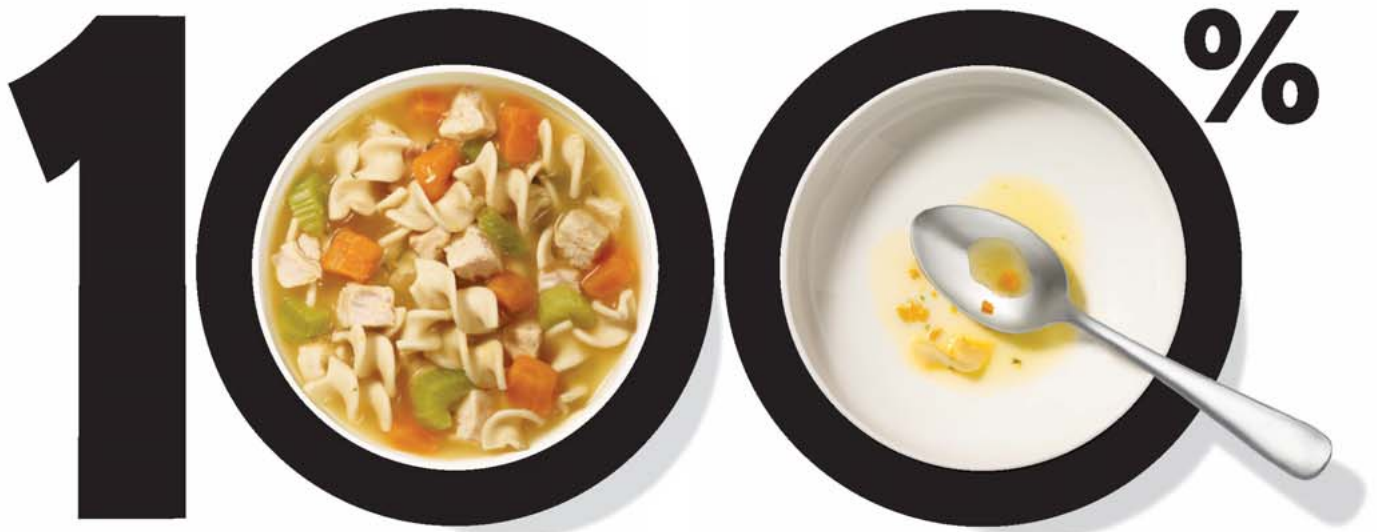
To hand-finish blades, fittings and handles, Foster needs sandpaper—and lots of it. A \$1500 knife may have \$5 worth of steel and \$50 worth of sandpaper invested in it.



Burt Foster has made knives that can chop through a 2 x 4, shave hair off an arm and bend 90 degrees. Spurred by a childhood fascination with the outdoors and knives, he decided at 29 to turn a longtime hobby into a profession. Only 114 people in the world—including Foster—hold the title of Master Bladesmith, which is bestowed on those who have at least four years of experience and can forge knives that withstand the American Bladesmith Society's rigorous tests. Foster works mostly by hand, spending between six and 50 hours on each creation. "Knifemaking is not like punching a clock," Foster says. "There are no templates or patterns. Very little of what I do is ever repeated exactly." — EMILY HAILE



**CAMPBELL'S® CHUNKY
CHICKEN NOODLE
IS NOW MADE WITH**



WHITE MEAT*



BETTER THAN EVER

©2009 CSC BRANDS LP
*All of the meat in this product is white.



THE OFFICIAL SOUP SPONSOR OF THE NFL
©2009 NFL Properties LLC. All NFL-related
trademarks are trademarks of the National Football League.