MIND & BODY
SPECIAL

Smart Fitness

THE FITTEST, FASTEST, AND STRONGEST among us don't always train harder – they train smarter. In recent years, science has discovered how we build muscle, endurance, and anaerobic speed. So why are you still working out like it's 1999 – or even 2009? It's time to stop taking advice from gym rats and start consulting research, using technology, and putting all that gathered intelligence to work. We asked trainers, scientists, and pro athletes how ordinary guys can get faster and go longer, and what we found out is that crunches don't make you stronger, hanging upside down can help you perform better upright, and sprinting for six minutes may be a better way to boost speed than biking hundreds of miles every day. Because there's a good chance the guy running six-minute miles on the treadmill next to you isn't naturally stronger – he just works out more intelligently.

Photographs by TURE LILLEGRAVEN

1 TURN YOUR WORKOUT UPSIDE DOWN

Fitness rebel and big-wave surfer **Laird Hamilton** wants you to do the opposite of everything gym rats tell you. **By Laird Hamilton**

I've been hanging upside down a lot lately. Nothing decompresses me more or has a better overall positive effect than that. It stretches and elongates my spine, gets blood flowing to my head, and takes pressure off my organs. Being upside down is the ultimate counterbalance to the repetitive motions we do in our vertical lives — walking, standing, paddle-boarding, sitting upright. There's a saying among yogis that a man who can stand on his head 20 minutes a day masters time. I haven't mastered time, but I do try to put in 20 minutes a day upside down — whether I'm doing a headstand or hanging from a harness in my garage — to provide a little counterbalance to the rest of my life.

And I never would have done it if I hadn't torn my ACL and been forced to really think about what I was doing to my body and why I needed to find a way to counteract the motions I was overdoing. I blamed the ACL injury on biking. I loved biking — I'd been riding hard a few hours every day — but the sheer volume of repetitive motion was killing me. It built up certain muscles — quads, hip flexors — while ignoring others, which was creating tightness in my lower back and IT band, and I wasn't doing a thing to counteract it. So I started riding backward.

At first, it was just a hunch, an unformed theory. I did it mainly because I hoped it would help me avoid injury. But then I started to see and feel the results, and that's where the revelation came in. When I went back to pedaling normally — that is, frontward — I discovered that I had a better relationship with my stroke. Not only did going backward counteract the repetitive motion that was causing my problems, it also improved my dexterity and coordination. It made my normal stroke feel more fluid and instinctive.

I later found out that backward pedaling is something world-class cyclists have been doing for years. I also discovered that Bruce Lee's method of punching faster was actually to try to recoil quicker. It's kind of counterintuitive — you think you'd be faster by speeding up the extension, but really your speed comes through the recoil. Normally you're thinking only about punching, so somewhere there's a shutoff in your consciousness, and you're not thinking about pulling back. But when you incorporate the muscles that it takes to pull back and initiate them into moving forward, you find the gain. It's like the muscles become more educated. We always say, "Train smarter, not harder," and ultimately, it's about enhancing performance. The irony is that what enhances performance also helps prevent injuries.

BETWEEN CURLS AND CRUNCHES AND SQUATS, WE'RE ALWAYS FOLDING IN ON OURSELVES. IT'S CRUCIAL TO REMEMBER TO OPEN UP AS WELL.

Once you start being conscious of the repetitive motions that we all just accept as part of being human, you realize how little we do to counteract those motions. Instead we usually go out of our way to do more of them. Think of working out in the gym. All the movements are about folding inward. Between curls and crunches and squats, we're always tightening and closing ourselves up. It's crucial to remember to open up as well — whether it's on a cable machine or with a weight, incorporate more movements where you're extending and opening yourself up. Coincidentally, they're harder to do and you don't need as much weight to do them. It's all an opposite reaction to how we normally do things.

Usually, working out is about aesthetics — six-pack abs and biceps and pecs — instead of true functionality. True function has a different aesthetic appeal. Of course, any kind of working out is better than no kind of working out. Everybody gets an endorphin high from it: You sweat, you eat good, you sleep better, sex is better — it's life-enhancing. All of this is positive stuff, but there are repercussions over time, and you risk blowing something out and just getting stiffer and stiffer over time.

You could still have all that — you could be ripped up and have all the guns and do all the deal and have all the power, but you're going to have to combat all that tightness with something. And if you do, your posture will be more open and you'll be better balanced. You may not look like you would if you did 500 sit-ups a day, but you'll perform better, and for me, training was always about enhancing performance. At the end of the day, it's really about running faster, jumping higher, hitting the ball better, and functioning better, so you can run and swim and do all these things you want to do. That's life.

THREE WAYS TO OPEN UP

Side Angle Stretch
This simple lunge provides a nice stretch to the psoas, a muscle that runs from your hip to your lower back. Lunge forward, keeping your right knee bent at 90 degrees and your back thigh as flat on the ground as safely as possible. Place your right palm on the floor next to the inside of your knee and extend your left arm over your head and forward, for a deep torso stretch.

Towel Stretch
One movement that's great for opening the chest is to take a towel or even a broomstick (just not a bungee or anything with too much give) and hold it with straight arms, at least shoulder-width apart. Then, keeping your arms straight, bring them behind you. This is a favorite of swimmers and free divers because it expands lung capacity while it opens the chest.

The Sumo
Ever see sumo wrestlers warm up by lifting their knees high and slapping their thighs? That's a great stretch for the lower back and a move that opens the hips on the sides, counteracting the linear hip motions we do all day long. It's especially good for men who are notoriously supertight in the hips. Try to do sets of 100.

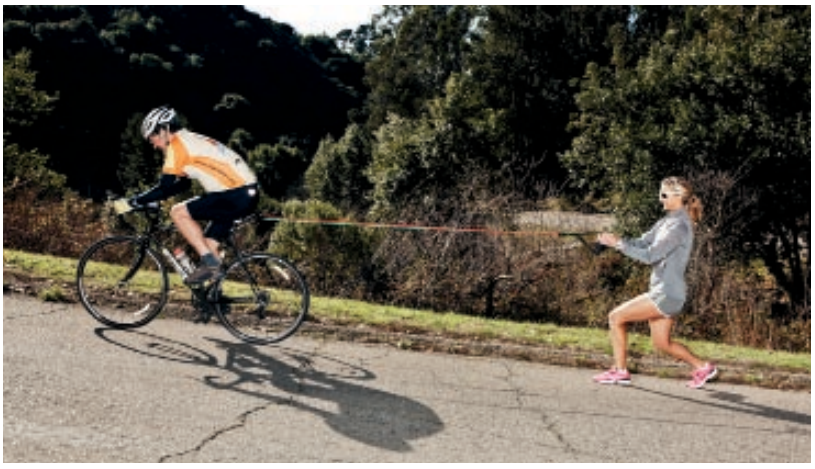
BEST RECOVERY DRINK: Gatorade *or* chocolate milk?

To build muscle and get fit faster, ditch the sugary sports drink and finish your next workout with a frothy glass of chocolate milk. Researchers at the University of Texas found that cyclists who drank chocolate milk after hard workouts improved their aerobic capacity two-fold in four weeks compared with those who gulped a carbohydrate-rich drink or water. Chocolate milk has the ideal ratio of carbs to protein — about 3-to-1 — that muscles need after hard exercise to recover and repair. Aim to drink eight to 14 ounces of low-fat chocolate milk immediately after an intense workout that lasts longer than 45 minutes. —CHRISTIE ASHWANDEN

ILLUSTRATIONS: DAVID WILSON

2 DATA + EFFORT = RESULTS

Everyone has an athletic sore spot. I can't bike uphill. But what if I spent a month and a half doing everything I could to improve? That was my **Six-Week Challenge**. By Andrew Leonard



My epiphany arrived 75 miles into Levi Leipheimer's GranFondo century ride, the Pacific Coast Highway behind me and most of a 1,100-foot hill looming above me. Thousands of riders had left me in the dust during the day, but this last climb was the worst. As I struggled to push my pedals, dozens of jerseys spun past me uphill. The truth hit: I've been riding hard for 10 years, and I still suck at hills. Although my job was busy and my parenting responsibilities intense, I vowed then to focus my will and make all necessary sacrifices: Somehow, someway, I was going to get up that damn hill faster.

WEEK 1 MORE SLEEP, FEWER BEERS

I start by talking to someone who knows bike training. Matt Dixon is an endurance-sports specialist who helps pro and amateur athletes maximize performance. The first thing he tells me isn't to do brutal workouts, but to start paying attention to good sleep and nutrition. Getting up early to squeeze in an extra ride can be self-defeating if you don't give your body time to recover. And without the right fuel at the right time, even the best training plan will be useless. So I cut out Sierra Nevada Pale Ale and Kettle chips and start getting eight hours of sleep every night.

Even though I'm sore from the GranFondo, I ride 61 miles for the week and lose four pounds. I also establish benchmarks up two local climbs — Tunnel and Spruce — that lead out of Berkeley to the East Bay ridgeline: 9.5 mph up Tunnel and 9.8 mph up Spruce. Neither is a backbreaker, but I've gnashed my teeth on their slopes for years as other riders sped by. If I'm going to become a better hill-climber, this is where it starts.

WEEK 2 INTERVALS

Dixon's regimen is built around intervals — short periods of intense effort followed by breaks of easy effort. In my 10 years of riding, I've never thought to do anything but ride, but now I start doing intervals at least once a week. After warming up, a typical workout starts with three six-minute intervals punctuated by two minutes of easy spinning, ending with four one-minute all-out sprints. I total 63 miles for the week and lose another four pounds. I'm also rewarded with an improvement — 10.6 mph up Spruce.

WEEK 3 THE LONG RIDE

It's not ideal to tackle a 100-mile ride in the middle of intense training, but one of the last big local centuries of the season, the Cruella Challenge, is too good to pass up. I feel great for most of the ride — it helps to be eight pounds lighter — and I average 0.5 mph faster than I did during the Fondo. Total mileage for the week: 159. I don't lose weight, but I don't gain any, either.

WEEK 4 HELL ON WHEELS

Dixon has loaned me a $1,500 bike trainer, an indoor machine that measures heart rate, energy output, and a dozen other things. I can set the resistance on my back wheel to simulate the toughest hill I want — and I hate it. It subtracts everything I love about riding — the outdoors, the triumph of the ascent, the glee of the downhill — with nothing but work. Under Dixon's direction, I spend my time attempting to pedal at 75 rpm or hold 200 watts despite increasing resistance. I ride 65 miles and lose two pounds, but at the end of the week, I average 10.7 mph up Spruce and actually pass other riders.

WEEK 5 REDEMPTION IN MY BASEMENT

I love the trainer. It's the perfect tool for people with busy lives. When the weather is bad or I get home late from work, the trainer is ready. I ride 93 miles this week, including intervals and more time on the trainer. The highlight comes during a ride I've done more than 50 times in the past two years — a 20-mile flat sprint on a trail that skirts the bay. This time, I set a personal record for the ride, averaging 17.8 mph, 2 mph faster than one month earlier. I don't lose any weight, but I tell myself that's because I'm building denser, heavier muscles.

WEEK 6 CRUSHING SPRUCE

I head out for a 20-mile ride that starts up Spruce and am rewarded with an all-time best — 11.3 mph — and a feeling of utter joy. In 10 years, I've ridden that hill at least 150 times, but the computer cannot lie: This was my fastest ascent ever. I ride 59 miles total.

For the six weeks, I ride 500 miles and drop 11 pounds. I indisputably improve my hill-climbing, but I'm not ready to call myself "fast" — I need to lose another 10 pounds and gain another 1 to 2 mph. And I'm not content, either. I'm already dreaming of next year's GranFondo. Maybe this time I'll be the rider who inspires someone else to finally get serious.

FASTEST WAY TO FITNESS: Tennis *or* biking?

This answer depends on whether you have more fast-twitch or slow-twitch muscle fibers. The former make you better at speed and strength sports; the latter predispose you to endurance exercise. If you're good at lifting heavy weights and playing sprinting sports like basketball and tennis, you're fast-twitch; if you prefer high reps and endurance exercise like running and cycling, you're slow-twitch. Fast-twitchers can get greater gains doing power workouts like tennis and plyometrics, and lifting heavier weights with fewer reps. Slow-twitch people can improve faster with long cardio — up to an hour or more at a time — and low weights and high reps. —CA

ILLUSTRATIONS: DAVID WILSON

3 ONLY YOUR BRAIN CAN SAVE YOUR BODY

Injuries used to be an inevitable side effect of exercise. No longer. Learn and adopt these **six rules for injury prevention**, and you may never get injured again. By Matt Fitzgerald

A few years ago, the Phoenix Suns looked more like an injury ward than a basketball team. Star point guard Steve Nash had missed multiple games due to chronic low-back pain, while the rest of the team struggled with various shoulder, hamstring, and knee injuries. Desperate for answers, the Suns hired the CEO of the National Academy of Sports Medicine, Mike Clark. Instead of plying traditional treatment techniques, he began diagnosing and correcting each player's muscle imbalances. Although this didn't instantly cure them, it did help prevent injuries from happening again or even in the first place. Three years later, Nash's problems were significantly better, and Suns players missed fewer games due to injury than the majority of other NBA teams.

A large percentage of men miss a day of work each year due to a physical injury. Yet the Suns' turnaround proves that you don't need luck, good genes, or costly procedures to prevent and treat sports injuries. You need a new set of rules, ones that will make you a stronger, faster, and better athlete in the process.

RULE 1 BE BALANCED

Almost everyone has muscle imbalances, which occur when a muscle on one side of a joint becomes too tight, while the muscle on the opposite side gets weak. Pronounced imbalances restrict physical movement and can damage muscles, in addition to ligaments and cartilage. One of the most common imbalances is having tight hip flexors and weak glute muscles, which can cause hamstring strains, groin pain, and sciatica.

Muscle imbalances are so ubiquitous because of the inordinate amount of time we spend sitting. "In our computer-centric workforce, we sit all day and tend to adopt slouched postures," says Darwin Fogt, owner of Evolution Physical Therapy in Culver City, California. Over time, prolonged slouching can create imbalances that predispose you to everything from low-back pain to shoulder tendonitis when you move from your desk or couch to the gym, pool, or golf course.

You might think that working out or playing a sport regularly would iron out any muscle disparities, but in fact, exercise can make them worse. If you're a cyclist, for example, you can count on a hunched-over pedaling position to overdevelop your quads while keeping your glutes weak. Even the fittest or most muscular athletes have hidden imbalances that will increase their injury risk significantly unless they target and fix them. So while Usain Bolt can run the 100-meter dash in 9.58 seconds when he's healthy, his career has been hampered by Achilles tendon and low-back injuries, both of which stem from the same kinds of muscle imbalances that plague weekend athletes.

As common as they are, muscle imbalances can at least be corrected. "If you stretch muscles that are overactive and strengthen muscles that are underactive, you can decrease your risk of injury and increase your performance," says Clark. The first step, though, is to identify your imbalances. Take this two-part DIY test, developed by Clark, to learn which muscles are weak. Next, find your weaknesses under "Cause" in the chart below and do the associated exercises in "Fix" to help prevent injuries. If you're already injured, take the test, but be sure to do those exercises specific to your problem.

TEST 1: Overhead squat Stand barefoot in front of a mirror with your feet shoulder-width apart and your arms extended overhead. Squat down to chair-height and then return to upright position. Repeat three times. If your feet turn outward as you squat, you probably have tight outer calves and weak inner calves. If your knees cave inward (move together), you may have weak glutes and tight adductors. If your lower back arches, you may have tight hip flexors, erector spine muscles, and weak abs and glutes. If your arms fall forward, you may have tight lat and pec muscles, and weak scapular muscles and rotator cuff muscles.

TEST 2: Single-leg squat Stand barefoot on one foot facing a mirror with hands on hips. Squat to a comfortable level and return to upright position. Repeat three times, switch feet, and then do three more squats. If your knees move inward, you may have tight groin muscles and weak glutes.

SIX FAST WAYS TO FIX INJURIES AND CURE MUSCLE IMBALANCES

INJURY	CAUSE	FIX
Achilles tendonitis	Weak inner-calf muscles	Do 20 heel raises with toes turned inward.
Calf strain	Tight outer calves	Sit with legs outstretched and toes pointed inward. Use a rope to pull your toes toward your knees. Hold for 20 seconds, and repeat.
Runner's knee	Weak gluteus medius Tight calves Tight adductors	Lie on your side with legs together and knees bent at 90 degrees. Open your top leg like a clamshell while keeping the heels of your feet together. Repeat 20 times and switch sides.
Sciatica	Tight hip flexors	Kneel on one knee and gently push your weight forward into the front of your hip. Hold for 20 seconds. Switch sides.
Low-back pain	Weak internal abs Weak gluteus maximus Weak hip flexors	From push-up position, drop elbows to the floor and hold your body in plank position in a perfect line for one minute.
Tennis elbow	Tight latissimus dorsi (lat muscles)	Kneeling, extend right arm in front to rest on a stability ball. Roll ball forward with your arm, sinking your weight onto the ball until you feel a stretch in your lat. Repeat with left arm.

illustrations by **MARK MATCHO**

RULE 2 TAKE TIME TO RECOVER

Every workout breaks your body down, causing inflammation in your muscles and joints. Although your body knows how to rebuild itself and will usually come back stronger, it needs time to do so. Most overuse injuries are nothing more than a failure to recover fully from the normal stress of exercise. You can't keep increasing how hard or long you work out without some negative effect, so alternate easy "recovery" days with intense or lengthy workouts. If you're striving toward a goal by increasing your training over time, take an active recovery break (reduce your activity load) every four weeks.

Pro athletes do everything they can to recover quickly — ice baths, massage — but only one factor other than rest has been proved to make a big difference: nutrition. "Studies show that consuming the right combo of carbs and protein within 45 minutes after high-intensity or prolonged exercise accelerates muscle repair, reduces inflammation, and improves performance in the next workout," says Robert Portman, author of *Hardwired for Fitness*. So be sure to eat a turkey sandwich or eggs with toast after a tough workout.

RULE 3 PRACTICE BEFORE YOU PLAY

Most injuries happen during what experts call "unaccustomed exertion" — meaning that you're more likely to sprain a knee during that annual ski trip than if you live at the base of a mountain and ski 100 days a year. It also means you're more likely to get injured when you resume physical activity after a few weeks off.

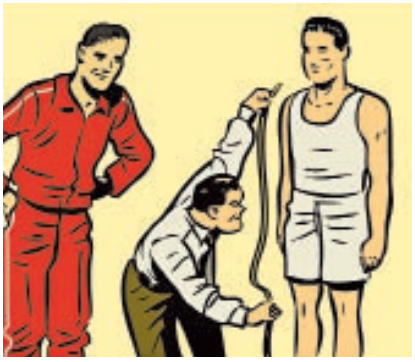
If you stay in good shape all the time, you can minimize unaccustomed exertion and avoid most injuries. But if you don't, there are still things you can do to protect yourself. At least six weeks before an annual ski trip, for example, "start a simple conditioning program to get your body ready," says Christine Springer, director of physical therapy at Sports Center Physical Therapy in Austin, Texas. Springer recommends a mix of muscle-balancing strength exercises like side lunges and stretches, plus mobility exercises like leg swings and balancing exercises like bicep curls while standing on one foot. "Even 15 minutes a day can make all the difference," she says.

RULE 4 KNOW WHEN TO CALL IT QUITS

Even the best athletes in the world have limits. The American record holder in the marathon and half-marathon, Ryan Hall, used to run 120 miles a week and push himself through every workout, no matter how bad he felt. As a result, he never made it to the starting line of the 2010 Chicago Marathon, where experts predicted he would set another American record. After this setback, he lowered his mileage and started taking days off. Six months later, he set a new American record at the Boston Marathon.

To respect your body's limits and avoid injury, start recording all your workouts, either on paper or with a fitness app like Gym Buddy. "Putting numbers on what you've done makes it easier to avoid the sudden increases in training that get people in trouble," says Rett Larson, director of sports performance development at Velocity Sports Performance.

Next, start listening to your body. "Most injuries are preceded by warning signs," Larson says. No matter what you think you ought to be able to do in a day, cut bait and rest if you feel unusual pain, soreness, or fatigue.



RULE 5 INVEST IN EQUIPMENT THAT FITS

Your body isn't the only thing to blame for an injury: Poorly fitting gear can be a culprit, too. A running shoe with too much cushioning may be fine for your friend, but if it's the wrong fit for your stride, it can give you Achilles tendonitis. Similarly, a tennis racquet with too much tension for your forearm can trigger elbow tendonitis, and a bike with a handlebar stem that's too long for your upper body can create pain in your upper back. To avoid being brought down by your own gear, seek help from professional fitters: Buy your running shoes at a specialty store that can perform a treadmill gait analysis, get a stringer to set the tension on your tennis racquet, and invest in a bike fit from a certified specialist.

RULE 6 WARM UP WITH DYNAMIC MOVES

In one 2008 study, college coaches cut the knee injuries of their soccer players by more than half when they asked the team to warm up by doing dynamic movements and balancing drills instead of static stretching, or holding cold muscles in place.

If you're wondering, "What the hell's wrong with stretching?" you're not alone. Most people warm up improperly or insufficiently because they static-stretch, which doesn't increase body temperature or blood flow to muscles. Instead, you'll get better results by adopting the pre-exercise routine of blood-pumping exercises that almost all high-level athletes now do before workouts. Below is the warm-up that the United States Tennis Association's strength and conditioning specialist, Rodney Marshall, uses with his pro players, including top 10–ranked Mardy Fish. Try these before you do exercises or play sports with side-to-side (lateral) movements as in tennis, basketball, football, Frisbee, baseball, soccer, and squash.

STEP 1: Warm and loosen muscles "Start with light jogging, arm circles, high knees, cariocas [move sideways by stepping your right foot in front of your left, then your right behind your left; change sides after 20 feet], and side shuffles," says Marshall. "When you've got a light sweat going, move on to the next step."

STEP 2: Dynamic flexibility and mobility "Do movements that take all your major joints through a wide range of motion," says Marshall. For example, stand and hug one knee to your chest, then take a giant lunge step forward with the same leg. Do six to eight of these to one side before switching legs. The exercise helps stretch muscles actively to prepare them for the force of exercise.

STEP 3: Specific movement preparation "The last step is to do sport-specific movements with low intensity," Marshall says. "We have our tennis players simulate forehand and backhand swings with a medicine ball." For other activities, do an action unique to that sport, like defensive slides (side shuffles in a semi-squat position) and backward running before you play basketball. Getting ready for a game of adult-league softball? Pretend you're Yankees closer Mariano Rivera and throw a few slow balls beforehand.

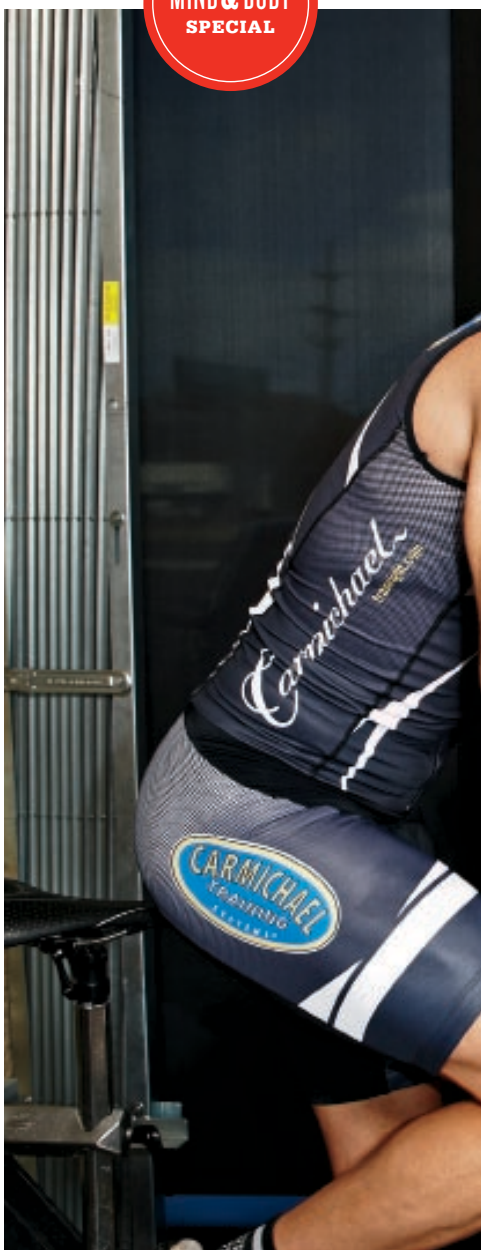
BEST AB WORKOUT: Crunches *or* planks?

If your ab workout amounts to a bunch of crunches done fast and furiously on a gym mat, it's time to rethink your routine. While crunches can help shape a six-pack, a new study from Indiana State University shows that they do little to strengthen your core. For this, you need stabilization exercises like abdominal bridges, side planks, lunges, and leg lifts, all of which challenge your body's balance and coordination while targeting key core muscles in your back, hips, and glutes. If these muscles are weak, you'll be more prone to injury, especially knee problems. Continue crunching to keep oblique muscles (along the side and across the stomach) in shape. —CA

ILLUSTRATIONS: DAVID WILSON

4 GET A GUIDE TO TAKE YOU TO THE NEXT LEVEL

Chris Carmichael coached Lance to the best performance of his life. Check out what he can do for you. **By Daniel Duane**



Chris Carmichael swerves his bike between a dead coyote and a shredded truck tire on Route 87, outside Tempe, Arizona. Behind and in front of him, 28 Ironman Recon Camp participants — each paying $1,800 for three days of coaching — pedal hard in the desert sun.

"I sometimes get approached by celebrities!" Carmichael shouts over the din from the 18-wheelers blowing past on the crowded roadway. "But you won't see me trying to be Trainer to the Stars. They're idiots! We had this one lady. She was like, 'I want my biceps to have that little cut look.'" He shakes his head with disgust. "Rock stars aren't so bad. But celebrities are douche bags! I don't train appearance. I train performance."

With the faintest hint of a paunch bulging beneath his Lycra cycling jersey, Carmichael, 51, doesn't fit the picture of a serious coach. He has a remarkably laid-back demeanor, slack-mouthed and a little distant, like a guy who's been to one too many Grateful Dead shows. Yet Carmichael has successfully trained athletes at the highest level, most notably Lance Armstrong during each of his seven Tour de France victories. He's also trained professional hockey players, elite swimmers, the entire U.S. cycling team, three Ironman world champions, and a series of athletes who have collected, altogether, 33 medals from Olympic, Pan American, and World Championship games. Carmichael began offering his coaching services to the masses in the late 1990s; today he runs the largest elite-level endurance-sports coaching business in the world.

Carmichael Training Systems (CTS), employs 30 full-time coaches who work with nearly 2,000 athletes at training camps like this one in Arizona, as well as online. The secret to Carmichael's success is his company's ability to take complicated technical data — like a nearly imperceptible change in your VO2 max, or the maximum volume of oxygen you can process during all-out effort — and make finely calibrated micro-adjustments to your training regimen that yield macro results. Take Matt Allaire, a 41-year-old recreational mountain biker from Orange County, California. Just one and a half years after signing up with CTS, he had finished three Ironman triathlons. "CTS helped me ramp up my volume, intensity, and stamina. They teach you the different phases of training and take the math out of it, so you know what you need to do to get to an event," says Allaire, who has five triathlon races on his 2012 calendar already.

Half a dozen CTS coaches follow the riders down the Arizona highway in shiny white vans, keeping the cyclists stocked with energy gels. The coaches offer encouragement, tips, and even some on-the-fly bike maintenance. Each bike has been equipped with a $2,000 rear wheel, which houses in-hub power meters to measure the wattage generated by every pedal stroke. The riders also wear GPS watches, heart-rate monitors, and pedaling-cadence sensors, all beaming a vast array of data to wireless computers mounted on each bicycle's handlebars.

Meanwhile, at a nearby hotel, another team of coaches armed with laptops waits to crunch the data as soon as the ride is over. Still more coaches at training centers in Colorado Springs; Tucson, Arizona; Santa Ynez, California; and Brevard, North Carolina, stand ready to plug the information into customized CTS training-and-nutrition plans, which are delivered to the campers via the internet.

CTS clients come from practically every walk of life and level of athletic ability. They range from potbellied bankers to former Division I jocks wanting, as Carmichael puts it, "to take their performance to the next level." Some stick to online coaching, but many others sign up for what Carmichael calls "big-ticket items: high-touch, high-dollar, high-value athletic experiences," such as the Recon Camps and race-support packages for extreme endurance competitions.

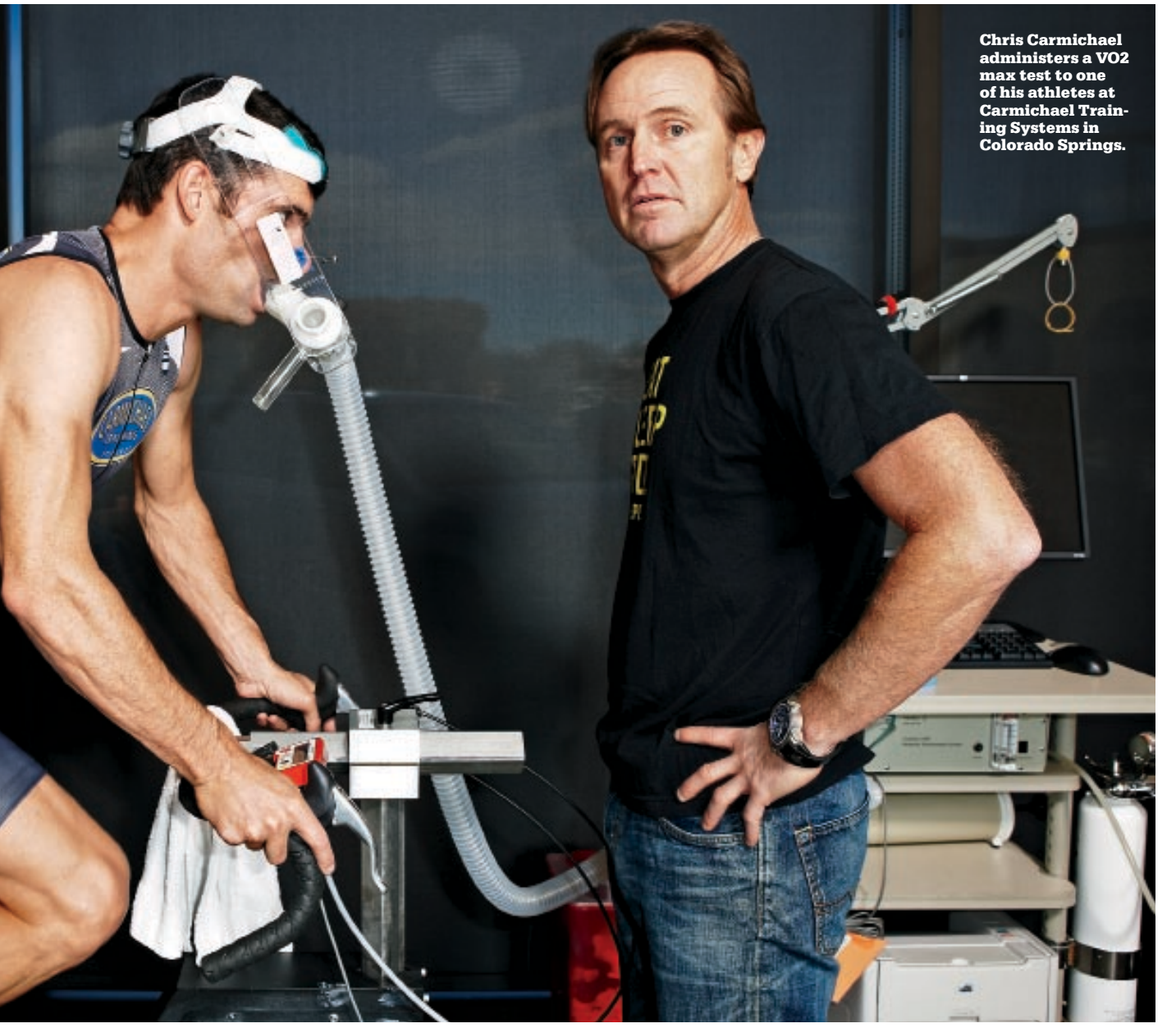
Participation in endurance sports happens to be booming. Last year's Boston Marathon sold out all 21,000 slots in a record eight hours, crushing the previous high mark of 62 days, which had been set just the year before. Eighty-two Ironman-branded events will take place worldwide this year, and all 178,000 slots available — up from 165,000 last year — will sell out online, just as this year's inaugural New York Ironman did, in 11 minutes flat.

"If you're going to sign up for stuff this hard, you can't fake your way through," Carmichael says. "From a business standpoint, that's our sweet spot. 'You want to do something grand, superbold?' We love that. Hey, excuse me here, OK?"

Carmichael stops talking suddenly, then — to quote the vernacular — drops me like a bad habit. There is no visible increase in effort, no strained standing in the saddle, no labored change in breathing. He is just gone, covering the 200-yard gap between him and one of his clients in seconds. He rides with the man for a while after that, chatting amiably, until the two of them, seemingly inspired by the pleasure of their conversation, speed off, vanishing into the hot distance.

Anyone can buy a power meter, heart-rate monitor, and GPS watch, and generate mountains of data about every workout. You can even crunch those numbers, for free, at sites like Trainingpeaks.com, or upgrade for a small fee and receive cookie-cutter training plans. But knowing enough exercise science to interpret it and make changes to your training over time is both complicated and time-consuming. Few coaches can analyze and individualize data like Carmichael can, especially for a mass audience.

CTS client Craig "Crowie" Alexander was already one of the fastest triathletes on the planet when he signed up in 2007. He'd successfully coached himself to a World Championship title in the Ironman 70.3 triathlon, which is half the length of a full



Chris Carmichael administers a VO2 max test to one of his athletes at Carmichael Training Systems in Colorado Springs.

Ironman. But for his 2008 debut in the full Ironman World Championship, a 140.6-mile race held annually in Kona, Hawaii, he sought out Carmichael.

CTS coach Nick White put Alexander through a barrage of physiological tests to establish his V02 max and his so-called lactate threshold, or upper limit for sustained effort. White noticed that Alexander's lactate threshold was already a quite high percentage of his V02 max, so he prescribed the counter-intuitive training solution of hard sprint intervals. "We figured the improvement in his V02 max would create some wiggle room for his lactate threshold to move up," White says. It seems to have worked: Alexander won that year's Ironman World Championship.

CTS can determine if a client's footfalls-per-minute while running are below peak performance and recommend cadence drills to increase it. They can calculate your optimal stroke rate in swimming — down to the hundredth of a second — and develop training sessions to help you achieve it. And it's more than just using these tests to push you harder. In fact, less is often more. Because many athletes tend to train too much rather than too little, CTS coaches are always looking for signs of fatigue. A disconnect between heart rate and running pace, for example, will show up in the uploaded data. If your pulse is running too high at a pace you typically find easy, CTS coaches know it's time to scale back your next few workouts.

Chris Carmichael started out in the mid-1980s as a professional cyclist for the 7-Eleven team, the first American outfit on the European circuit. He made the 1984 U.S.

BEST WAY TO LOSE WEIGHT: Endless cardio *or* short-burst intervals?

For years, you've heard the best way to lose weight is by slogging through hours of exercise in your so-called "fat-burning zone." But making workouts shorter and harder can burn fat more quickly than long, slow exercise. Boost your exercise intensity with intervals, or short bouts of hard effort followed by active rest — research shows that adding intervals creates a bigger calorie deficit than sustained exercise, forcing your body to burn more fat as fuel. Shoot to do four to six three- to five-minute intervals, with three minutes of slow recovery between, while running, cycling, swimming, or doing a cardio machine like the elliptical trainer. —CA

ILLUSTRATIONS: DAVID WILSON

Olympic team and rode with the first American team to compete in the Tour de France in 1986 (his team placed 63rd out of 132). Still, Carmichael is the first to admit that he was never the best rider. "I'm a better coach than I was an athlete," he says.

He found his calling only after he quit racing and USA Cycling hired him to run its athlete-development camps. One day, a promising young rider named Lance Armstrong showed up at one of those camps and Carmichael began working with him. Soon Armstrong was demolishing the competition in major European bike races, and Carmichael was promoted to national coaching director for all of USA Cycling. After resigning from the post four years later, Carmichael retreated to the hills of Boone, North Carolina, to help his old prodigy, Lance, launch his comeback from testicular cancer. He would go on to coach Armstrong to seven Tour de France wins.

Carmichael wasn't only focused on Armstrong, though. He saw the potential of the internet to scale up his data-driven business, taking it beyond direct relationships with individual athletes, so he began laying the foundation for a larger coaching business. He also saw the internet's pitfalls: the sense of remoteness, of clients wondering if there's a human out there or just a computer program. Carmichael understood more than anyone else that person-to-person contact — one human being motivating another — is as critical to successful coaching as crunching numbers.

He developed clear guidelines for coach-athlete interactions. He founded his own coaching college and taught every coach as much as he could about psychology, training language, and philosophy. CTS employs only full-time, salaried coaches: no subcontractors. Carmichael's brick-and-mortar training centers allow CTS clients to meet their online coaches face to face, as do the Recon Camps, which are held nearly every weekend around the country. Carmichael plans to open more training centers in cycling destinations in New England; the Texas Hill Country; Majorca, Spain; and elsewhere.

Although Carmichael has never been the only player in this field, he is by far the biggest. Joe Friel started Trainingbible.com shortly after Carmichael started CTS, and while Friel considers his company one of the largest of its kind in the world, he admits that CTS dwarfs it. "In terms of numbers of coaches, athletes, world outreach, and financial backing, CTS is the thousand-pound gorilla in the room," Friel says. CTS is also the most commercially successful of these coaching companies. "Everyone in the industry is envious of his business team and his business savviness," says Dave Scott, six-time Ironman world champion and a widely respected coach to elite triathletes.

Carmichael confesses to his fair share of professional missteps. "We tried shit that didn't work," he says. "When Lance retired: 'Oh, we're going to broaden up and be sort of general fitness, health, and wellness.' I even wrote a book called *5 Essentials for a Winning Life* — health, fitness, relationships, career, and nutrition. But does somebody really want to hear from Chris Carmichael about improving your sex life?"

"IF YOU SIGN UP FOR STUFF THIS HARD, YOU CAN'T FAKE YOUR WAY THROUGH. THAT'S OUR SWEET SPOT. YOU WANT TO DO SOMETHING GRAND, SUPERBOLD? WE LOVE THAT."

Now, Carmichael says, he's just doubling down on what he's always done best: helping athletes surprise themselves. Much of this, he admits, happens through the somewhat out-of-reach package deals targeted to the athletic rich — Carmichael aims to become the go-to source for bored millionaires with ambition to burn. "You want to do La Ruta de los Conquistadores in Costa Rica, the hardest motherfucking mountain-biking stage race in the world?" Carmichael says. "You come to us, and we're going to get you through, not only because we're going to train you. We're going to make sure you stay in the right hotels, you're not waiting around four hours for a bus. Before you know it, after a stage, you're back in that room getting a massage."

Just as the midday sun was pounding against the Route 87 asphalt, the last of Carmichael's riders — myself included — rolled into the Recon Camp's host hotel, the Tempe Mission Palms, a few blocks from Arizona State University. After 75 miles of up-and-down riding along the shoulder of a Sunbelt freeway, the athletes could have been forgiven for crawling to their air-conditioned hotel rooms. Instead, everyone spreads out among the tables in the hotel's shady courtyard while coaches walk around with laptops, showing each rider the numbers from the power meters and heart-rate monitors. Then the coaches herd everyone back into the white vans and drive us to a nearby pool for a swimming session, in which our strokes are captured by an underwater CoachCam. Then it's off to dinner at a suitably healthy Tempe eatery owned by Mark Tarbell, Carmichael's collaborator on *Chris Carmichael's Fitness Cookbook*.

This kind of training regime, with progressively more difficult and intense sessions carefully planned over several months, is the key to expanding an athlete's aerobic capacity and making him peak for a key event. Carmichael admits that digital devices and the internet make this considerably easier, given that a coach can now have an intimate understanding of your every workout, no matter where you are. But he insists technology is only part of the equation.

"I think I played a very important role in bringing science into endurance training," Carmichael says, slouched in the restaurant's banquette. "But when I hear people saying, 'Well, we're more scientific, so we're better coaches,' I say, 'That's bullshit. Science doesn't win competitions; inspired athletes win competitions.' And the foundation of coaching comes down to your ability to inspire." Carmichael's coaches are picking at the appetizers and listening closely as he brings up Armstrong again. "The greatest thing I learned from Lance is that he's not afraid to fail," Carmichael says. "People watch him attack and say, 'He's so confident; he knows he's going to win.' I'd say that he knows the only way he's going to win is to attack."

Carmichael also learned from Armstrong the value of forcing athletes to declare themselves 100 percent ready for competition. "Most athletes say, 'Yeah, I'm prepared, but I missed a bit of training with this injury, or whatever,'" Carmichael says. "They're laying the foundation of an excuse. If you say, 'Yeah, I'm 100 percent ready, and if somebody's going to beat me, they're going to have to go through me' — then if they do beat you, it means they're better than you. Lance didn't have a problem saying that."

Then Carmichael cut dinner short — after a grand total of zero alcoholic beverages, among 12 guys. We needed our rest, he said. The following morning we would be up at 7 AM, pulling on sneakers to preview the 26.2-mile running portion of the Ford Ironman Arizona. The more serious athletes, those with hopes of a podium finish, will crank out 18 miles before breakfast. They'll all be getting stride tips from the coaches, and all that data will join the rest of it, informing their training plans for the weeks and months ahead. If they talk to Carmichael himself, they might get a final earful about what he says is the number one thing he tries to teach athletes: "You do not quit. If you lose a body part, you maybe contemplate quitting. Otherwise, you do not quit."

That's big talk for amateurs out to find a little satisfaction, or personal growth. But Carmichael believes we need the big talk if we want to pull off something huge. He just may be right. ■