

Take Two Hours of Pine Forest and Call Me in the Morning

These days, screen-addicted Americans are more stressed out and distracted than ever. And there’s no app for that. But there is a radically simple remedy: get outside. Florence Williams travels to the deep woods of Japan, where researchers are backing up the theory that nature can lower your blood pressure, fight off depression—and even prevent cancer.



Florence Williams
(/1741256/florence-williams)

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I was supposed to be listening to the cicadas and the sound of a flowing creek when a Mitsubishi van rumbled across a small steel bridge just downstream. It was probably depositing campers at a nearby tent village, where kids were running around with their fishing poles and pink bed pillows. This was nature, Japan style. I was in Chichibu-Tama-Kai National Park, a 75-minute train ride northwest of Tokyo, with half a dozen other hikers out for a dose of *shinrin-yoku*, or forest bathing. The Japanese go crazy for this practice, which is standard preventive medicine here. It essentially involves hanging out in the woods. It's not about wilderness; it's about the nature-civilization hybrid the Japanese have cultivated for thousands of years. You stroll a little, maybe write a haiku, crack open a spicebush twig and inhale its woody, sassy scent.

The Outside RX

Six natural prescriptions for improving your body and mind.

(<http://www.outsideonline.com/fitness/wellness/The-Outside-RX.html>)

"People come out from the city and literally shower in the greenery," our guide Kunio explained. "This way they are able to become relaxed." To help us along, Kunio—a volunteer ranger—had us standing still on a hillside, facing the creek, with our arms at our sides. I glanced around. We looked like earthlings transfixed by the light of the beamship. Or extras in a magical-kingdom movie. Kunio could have been one of the seven dwarves. Elfin, with noticeably large ears, he told us to breathe in for a count of seven, hold for five, release. "Concentrate on your belly," he said.

Free Medicine

How research supports the therapeutic benefits of playing outside.

(<http://www.outsideonline.com/fitness/wellness/Free-Medicine.html>)

We needed this. Most of us were urban desk jockeys, including Tokyo businessman Ito Tatsuya, 41, standing next to me. Like many Japanese day hikers, he was carrying an inordinate amount of gear, much of it dangling from his belt: a cell phone, a camera, a water bottle, and a set of keys. The Japanese would make great Boy Scouts, which is probably why they make such fervent office workers, logging longer hours than almost anyone else in the developed world. They've even coined a term, *karoshi*, meaning death by overwork. Since he began lollygagging in the woods and picnicking on octopus, Ito's shoulders seemed to be unclenching by the minute.

"When I'm out here, I don't think about things," he said.

"What's the Japanese word for stress?" I asked.

"Stress," he said.

The Nature Cure

Looking at pictures of nature can be enough to make you feel better. (<http://www.outsideonline.com/fitness/wellness/The-Nature-Cure.html>)

WITH THE LARGEST CONCENTRATION of broad-leafed evergreens in Japan, mountainous Chichibu-Tama-Kai is an ideal place to put into practice the newest principles of wellness science. In a grove of rod-straight Japanese red pine, Kunio pulled a thermos from his massive daypack and served us some mountain-grown, bark-flavored wasabi-root tea. The idea with *shinrin-yoku*, a term coined by the government in 1982 but inspired by ancient Shinto and Buddhist practices, is to let nature enter your body through all five senses, and this was the taste part. I stretched out across the top of a cool, mossy boulder. A duck quacked. I was feeling pretty mellow, and tests would soon validate this: between the beginning and the end of the two-hour hike, my blood pressure had dropped a couple of points. Ito's had dropped even more.

We knew this because we were on one of Japan's 48 official Forest Therapy trails, designated for *shinrin-yoku* by Japan's Forestry Agency (<http://www.maff.go.jp/e/index.html>). In an effort to benefit the Japanese and find nonextractive ways to use forests, which cover 67 percent of the country's landmass, the government has funded about \$4 million in forest-bathing research since 2004. It intends to designate a total of 100 Forest Therapy sites within 10 years. Visitors here are routinely hauled off to a cabin where rangers measure their blood pressure, part of an effort to provide ever more data to support the project.



The Japanese have good reason to require unwinding: In addition to those long workdays, pressure and competition for schools and jobs have helped Japan achieve the third-highest suicide rate in the developed world (after South Korea and Hungary). Ten percent of the country's 128 million residents live in greater Tokyo, where rush hour is so crowded that white-gloved workers shove people onto Metro trains, leading to another coinage, *tsukin-jigoku*—commuter hell. On top of all that, the small island nation trembles and yaws with more than 1,500 earthquakes a year. The tsunami that hit in 2011 killed 20,000 people, the Fukushima Daiichi nuclear plant suffered a triple meltdown, and now some of the country's prized rice has radioactive cesium in it.

So it makes sense that Japan's scientists are in the vanguard of knowing how green spaces soothe the body and brain. While a small but impressive shelf of psychological research in recent decades suggests that spending time in nature improves cognition, relieves anxiety and depression, and even boosts empathy, scientists in Japan are measuring what's actually happening to our cells and neurons. Led by Yoshifumi Miyazaki from the University of Chiba (<http://www.chiba-u.ac.jp/e/>) and Qing Li from the Nippon Medical School (<http://www.nms.ac.jp/jnms/>) in Tokyo, they're using field tests, hormone analysis, and new brain-imaging technology to uncover how the magic works on a molecular level. Once we know that, it's news we can use.

"The Japanese work is essential, a Rosetta stone," says Alan C. Logan, co-author of the recent book *Your Brain on Nature* (<http://www.yourbrainonnature.com/>). "We have to validate the ideas scientifically, through stress physiology, or we're still stuck at Walden Pond." Americans have often relegated nature to the romantic realm of Thoreau and Abbey. Viewing it as medicine is still largely foreign. "Studying the impact of the natural world on the brain is actually a scandalously new idea," says Richard Louv, author of the 2008 bestseller *Last Child in the Woods* (<http://www.amazon.com/Last-Child-Woods-Children-Nature-Deficit/dp/1565123913>)—the book that minted the term *nature deficit disorder*—and *The Nature Principle* (http://www.amazon.com/The-Nature-Principle-Reconnecting-Virtual/dp/161620141X/ref=pd_sim_b_1), his 2010 follow-up about adults. "It should've been studied 30 to 50 years ago."

But the Japanese evidence is appearing at a good time. Books like Louv's, combined with an explosion in new digital distractions and malaises, are helping to define a cultural moment, what might be called a new slow-nature movement. We are rediscovering our inherent biophilia—what Harvard entomologist E. O. Wilson and Yale social ecologist Stephen Kellert defined as humanity's affinity for nature. And we see now that we have become what John Muir described as "tired, nerve-shaken, over-civilized people."

Indeed, in 2008, the world reached a curious milestone: more people lived in urban areas than outside of them. In the U.S., urban areas grew faster in 2010 and 2011 than suburban regions for the first time since the 1920s. According to Nicholas Carr's 2010 book *The Shallows* (http://www.amazon.com/Shallows-Internet-Changing-Think-Remember/dp/1848872275/ref=sr_1_2?s=books&ie=UTF8&qid=1352228393&sr=1-2&keywords=the+shallows), the average American spends at least eight hours a day looking at some sort of electronic screen. Then we try to relax by watching TV. Bad idea. Research shows that this only makes us crabbier. Logan asserts that, since the age of the Internet, North Americans have become more aggressive, more narcissistic, more distracted, more depressed, and less cognitively nimble. Oh yeah, and fatter.

And don't think you're off the hook if you exercise outdoors. You are quite likely still tethered to civilization. Perhaps you're strapped to a heart monitor or headset. Admit it: Have you brought your phone? Are you clocking wind sprints? Sure, you are deriving some mental and physical benefits, but evidence is mounting that to get the most out of nature, you really need to be present in it, not distracted by your own great story of self.

I reflect most of these trends. I spend too much time sitting inside. I maintain multiple social-media platforms, and I've recently moved from idyllic Boulder, Colorado, to Washington, D.C. Now my morning walk takes place directly under the flight path of Reagan National Airport. I dodge surly bike commuters and professional dog walkers, then cross a car-clogged parkway that sets me grumbling and obsessing over my fate, my relationships, and my kids' new schedules, which require military precision and Euclidean traffic calculations. When I walk under a bridge to get to something resembling a trail, I pass graffiti that reads PUSSY FUDGE. I'm feeling a bit. On. Edge.

IF THE JAPANESE EMBRACE of forest therapy can be attributed to one man, it's Miyazaki, a physiological anthropologist and vice director of Chiba University's Center for Environment, Health, and Field Sciences, located just outside Tokyo. Miyazaki believes that because humans evolved in nature, it's where we feel most comfortable, even if we don't always know it. "Throughout our evolution, we've spent 99.9 percent of our time in natural environments," he says. "Our physiological functions are still adapted to it. During everyday life, a feeling of comfort can be achieved if our rhythms are synchronized with those of the environment."



To prove it, Miyazaki has taken more than 600 research subjects into the woods since 2004. He and his colleague Juyoung Lee, also of Chiba University, have found that leisurely forest walks, compared with urban walks, yield a 12.4 percent decrease in the stress hormone cortisol, a seven percent decrease in sympathetic nerve activity, a 1.4 percent decrease in blood pressure, and a 5.8 percent decrease in heart rate. On subjective tests, study participants also report better moods and lower anxiety.

As Miyazaki concludes in a 2011 paper, “This shows that stressful states can be relieved by forest therapy.” And the Japanese eat it up, with nearly a quarter of the population partaking in some way. Between 2.5 million and five million visitors walk the Forest Therapy trails each year.

The science is so convincing that other countries are following Japan’s lead in studying and promoting nature as a cure. Lee just got hired away by the South Korean government, which is pouring more than \$140 million into a new National Forest Therapy Center, expected to be completed in 2014. Finland, an empire of boreal spruce and pine, is also funding numerous studies. “Japan showed us that there could be cooperation between forestry and medical fields,” says Liisa Tyrvaïnen of the Finnish Forest Research Institute. “Now we are conducting similar research.”

I met up with Miyazaki at the country’s newest proposed therapy site, Juniko, a leafy network of trails and lakes near northern Japan’s Shirakami Mountains. The scientist was swatting mosquitoes from his face and neatly trimmed gray hair. In fact, he wasn’t looking relaxed at all. He was worried that the trail might be too muddy for his latest experiment, which would inaugurate the new field version of a brain-oxygen measuring, near-infrared spectrometer. He was kicking rocks out of the way and overseeing the setup of a netted, canopied mini-lab. The next morning, he and Lee would bring 12 male college students here, to measure their brain activity and vital signs after walking and sitting and generally forest bathing. They’d repeat the experiment in downtown Hirosaki, a city of 175,000 about two hours away. I would serve as one of Miyazaki’s stressed guinea pigs.

With the details worked out, several of us retired to a quiet restaurant across from Hirosaki’s Dormy Inn. We removed our shoes and sat cross-legged on the floor while Miyazaki distributed a baffling array of dishes involving runny eggs, seaweed, and gelatinous balls.

“Why do the Japanese think about nature so much?” I asked Miyazaki, who was preparing to eat his modest slab of manta ray.

“Don’t Americans think about nature?” he asked me.

I considered. “Some do and some don’t.”

“Well,” he mused, “in our culture, nature is part of our minds and bodies and philosophy. In our tradition, all things are relative to something else. In Western thought, all things are absolute.”

Maybe it was the sake, but he was starting to lose me.

“The difference is in language,” he continued. “If I ask you, ‘A human is not a dog, is it?’ you say, ‘No, a human is not a dog.’ In Japan, we say, ‘Yes, a human is not a dog.’” The great sensei of nature studies peered at me over his chopsticks. I was reminded of the story of the Zen student who asks his teacher, “How do you see so much?” and the teacher responds, “I close my eyes.”

Miyazaki, I understood, was like a koan, impenetrable. But you had to trust that the guy was onto something.

ON THE MORNING OF the forest experiment, the college kids and I took turns sitting in the mobile lab at the trailhead. The boys were skinny, sleepy-eyed, and unfailingly polite. As if we were receiving sacrament, we placed hard cotton cylinders under our tongues for two minutes, then spit them out into test tubes. Once analyzed in a lab, these samples would reveal our levels of salivary cortisol, a stress hormone made in the adrenal cortex and sent to the brain. Lee, exuding calm and efficiency, hooked us up to other electrodes and devices that would track changes in blood pressure, pulse rate, and heart rate, gauging our physiological responses to the forest and the city.

These are standard measurements the team has used for years. But today they also pulled out the new battery powered spectrometer, which, when deployed, gave me a sensation of leeches sticking to my forehead. It’s designed to measure hemoglobin levels (a proxy for blood and oxygen) in the prefrontal cortex. This is the brain geography that deals with cognitive and executive functions, such as planning, problem solving, and decision making. When aggregated, these metrics paint a picture of our bifurcated nervous system.



The researchers want to know if being in nature gives these frontal lobes a much needed rest. When we are relaxed and at ease in our environment, our parasympathetic system—sometimes called the rest-and-digest branch—kicks in, stimulating appetite. This is why food tastes better in the outdoors, explained Miyazaki. But the constant stimulus of modern life triggers our sympathetic nervous system, which governs fight-or-flight behaviors. And triggers it, and triggers it. A long trail of research dating back to the 1930s shows that people with chronically high cortisol levels and blood pressure are more prone to heart disease and depression.

When it was my turn to wander through the forest for 15 minutes, I was happy to break free from the wires. The loud pulse of cicadas echoed through the woods. Light filtered gently through the beeches and Japanese horse chestnuts, and the earth smelled like, well, earth. An elderly couple ambled by, assisted by walking sticks and a bear bell. I was briefly mesmerized by a yellow butterfly. I could see why Juniko is a candidate for the country's next forest-therapy station. Local and park officials are seeking the designation because, where there's forest therapy, there are tourists and their yen. Miyazaki may have a mystical side, but what drives him is the data he gets from these parks. It's a convenient arrangement.

This isn't an entirely new idea. Beginning in the 1970s, researchers at the University of Michigan (<http://www.umich.edu/>), led by Rachel and Stephen Kaplan, noticed that psychological distress was often related to mental fatigue. Modern life demands what the Kaplans call sustained directed attention on tasks both important and mundane—checking email, working a desk job, finding a parking spot. What leads to resting our brains' directed-attention function? "Soft fascination," explains Rachel Kaplan from her plant-filled university office. This is what happens when you watch a butterfly or the sunset or rain. You can't help but stop multitasking or kvetching. That's why Kaplan recommends a decidedly nonathletic approach to the outdoors, at least at times.

"When you're pursuing a sport, you get cardiac points, but you're not necessarily getting nature points," she says. Research by her colleague Jason Duvall suggests that when you are distracted outside—running with an iPod, say—you may be more irritable and impatient later, less able to stay on task, focus, and plan than your nature-engaged peers.

Studies by the Kaplans and others show that after short walks in greenery, or even spells of looking at nature images in a lab, subjects' directed-attention capabilities at least partly recover—people perform significantly better on cognitive tests and report feeling happier. They behave less selfishly when playing computer games. Turning down the front-brain disco ball also seems to improve creativity. And the more time in nature, the better. A recent pilot study by psychologists Paul and Ruth Ann Atchley of the University of Kansas (<http://www.ku.edu/>) and David Strayer of the University of Utah (<http://www.utah.edu/>) found that after three days of hiking and camping in the wilderness, participants in an Outward Bound course improved their scores on tests of creativity by 50 percent. "I'll admit I'm a believer that there's something profound going on," says Strayer.

Yet, it's been hard to see inside the brain to observe these processes at work. Neuroscientists want quantitative visuals. That's starting to happen, mostly in labs in South Korea and the U.S. Studies have shown that when subjects look at pictures of nature, hemoglobin levels drop in the prefrontal cortex, meaning that the home base of executive function has switched a few lights off. (Similar effects have been seen in the brains of Tibetan monks, who appear to dim their brain wattage through meditation.)

Where's the action going instead? To other parts of the brain, like the insula and the basal ganglia, says Kaplan protégé Marc Berman, now at the University of Toronto's Rotman Research Institute. These are areas sometimes associated with emotion, pleasure, and empathy.

Berman has recently begun using functional MRI to watch people's brains as they look at images of nature through virtual-reality glasses. "What we're trying to find out is, what does a restored brain look like, and what does it look like as it's getting restored?" says Berman. In the real world, filled with real nature, he would expect the effects to be even more pronounced. Miyazaki and Lee, with their hemoglobin-measuring spectrometer, intend to find out.

TWO WEEKS AFTER OUR experiments at Juniko and Hirosaki, Lee sent me preliminary results from my brain spectroscopy. Brightly colored squiggly lines on a graph show that my oxyhemoglobin concentrations indeed appeared lower in the forest than in the city. Lee said that results from me and the college boys would require more analysis, but for first-time field work he was optimistic. "I am very excited," he said.

The results didn't surprise me. My urban peregrination hadn't been nearly as pleasant as the soft green trails of Juniko. Downtown Hirosaki is, like a lot of midsize cities, more functional than attractive. Walking on the hot asphalt, I passed four parking lots, two taxi stands, a bus station, and two loudly idling buses belching fumes. The results showed that my nervous system had responded. My systolic blood pressure had dropped six points after walking in the forest; obligingly, it went up six points after walking in the city.



But how long do the feel-good effects of nature last? Are they simply wiped out by the first traffic jam or cell-phone ditty?

One of Miyazaki's collaborators, Qing Li, an immunologist in the department of hygiene and public health at Nippon Medical School in Tokyo, had the same question. The chairman of the Society of Forest Medicine (<http://infom.org/>), a small but growing international group of academics, Li is interested in nature's effect on the human immune system. A person's natural killer immune cells (NK cells for short) can, like cortisol and hemoglobin, be reliably measured in a lab. A type of white blood cell, NK cells are handy to have around, since they send self-destruct messages to tumors and virus-infected cells. It's been known for a long time that factors like stress, aging, and pesticides can reduce your NK count, at least temporarily. So, Li wondered, if nature reduces stress, could it also increase your NK cells and thereby help you fight infections and cancer?

In 2005 and 2006, Li brought a group of middle-aged Tokyo businessmen into the woods. For three days, they hiked in the morning and again in the afternoon. By the end, blood tests showed that their NK cells had increased 40 percent. A month later, their NK count was still 15 percent higher than when they started. By contrast, during urban walking trips, NK levels didn't change.

Since most of us can't spend three days a week walking in the woods, Li was curious to know if a one-day trip to a suburban park would have a similar effect. It did, boosting the levels of both NK cells and anticancer proteins for at least seven days afterward.

What was going on? Li suspected that trees were important. Specifically, he wondered if NK cells are affected by "aromatic volatile substances," otherwise known as scents, sometimes called phytoncides. These are the pinenes, limonenes, and other aerosols emitted by evergreens and many other trees. Scientists have identified 50 to 100 of these phytoncides in the Japanese countryside and virtually none in city air that's not directly above a park.

This wasn't a totally left-field idea. Studies have attributed healthful properties to soil compounds like actinomycetes, which the human nose can detect at concentrations of 10 parts per trillion. And since the mid-1990s, researchers have been studying pinene for its antimicrobial properties and limonene, which is given off by citrus and other trees, as a possible tumor suppressor in cancer patients.

To test the phytoncide theory, Li sequestered 12 subjects in hotel rooms. In some rooms, he rigged a humidifier to vaporize stem oil from common Hinoki cypress trees; other rooms got nothing. The results? The cypress dwellers had a 20 percent increase in NK cells during their three-night stay and reported feeling less fatigued. The control group saw almost no changes.

"It's like a miracle drug," said Li.

It sounds hokey that evergreen scents—the kind of thing given off by those cardboard trees dangling from the rearview mirrors of taxicabs—could help us live longer. But Li found similar results with NK cells in a petri dish: they increased in the presence of aromatic cypress molecules. So did anti-cancer proteins and proteases called granulysin, granzymes A and B, and perforin, which act by causing tumor cells to self-destruct. Li's olfaction theory is unconventional, but it contains some of that Zen five-sense wisdom. While American researchers are mostly showing people pictures of nature, the Japanese are pouring it into every orifice.

Li invited me to his lab to have a sniff. The building was practically empty—the medical students were on break—and eerily dark, the result of power shortages in the wake of the Fukushima nuclear disaster.

He held up a small cinnamon-colored glass bottle filled with oil. "This is very toxic!" he said, giggling. "It's very good but very toxic." Phytoncides, from the Greek and Latin for "plant" and "killer," are antimicrobial compounds that ward off pests. At low levels, though, we find them pleasant, and sometimes we don't consciously detect them at all. Li believes that, while being around big trees in forests offers us the greatest benefit, flora from other landscapes, and possibly even houseplants, release these substances, too.

Before taking a drag, I stuffed my right arm into yet another blood-pressure machine. Then we unscrewed the cap of the forest elixir and I inhaled. The oil gave off a nice pitchy, vaguely turpentine scent. We put the cap back on and read my blood pressure again. It had dropped 12 points.

I looked at Li, who nodded delightedly. "This is a very big effect, bigger than people get with pharmaceuticals," he said. "In fact, I use a humidifier with cypress oil almost every night in the winter." You don't need to harvest your own, Li said. Standard health-store aromatherapy oils work fine.

"What else do you do?" I asked the middle-aged man with the bowl haircut.



Clearly, Li gets asked this a lot. He had a small list. “If you have time for a vacation, don’t go to a city. Go to a natural area. Try to go one weekend a month. Visit a park at least once a week. Gardening is good. On urban walks, try to walk under trees, not across fields. Go to a quiet place. Near water is also good.”

My morning walk back in D.C. was transforming before my eyes.

WE DON’T NEED A scientist to tell us that flowers and chirping birds make us feel good. But if the benefits of getting outside are so intuitive, why don’t more of us do it? Nature-based recreation has declined 35 percent in the U.S. in the past four decades, according to the *Proceedings of the National Academy of Sciences* (<http://www.pnas.org/>). We underestimate the curative effects, or perhaps we’re just too readily beguiled by the easy entertainments of technology. But will having more data about how nature works on our bodies lure us into the woods? We know we’re supposed to eat more leafy greens, but most of us don’t.

The kale analogy is pretty apt, because it turns out that even when we don’t enjoy spending time in nature, like during lousy winter conditions, we benefit from it just the same. At least that’s what Toronto’s Berman found when research subjects took walks in an arboretum on a blustery winter day. The walkers didn’t really enjoy themselves, but they still performed much better on tests measuring short-term memory and attention.

Japanese researchers understand our draw to nature, but American researchers understand our pull away from it—our distractions, inertia, and addictions. They want to help motivate us, to make our doses of nature so palatable and efficient that we hardly notice them. This is the next frontier in forest-therapy science, all aided by brain imaging.

Berman, for example, wants to figure out exactly which features (ponds, trees, biodiversity) yield the biggest bang in the brain. The idea is that once researchers know more about what makes our brains happy, that information can be fed into public-policy decisions, urban planning, and architectural design. The research has profound implications for schools, hospitals, prisons, and public housing. Imagine bigger windows, more trees in cities, and mandatory lie-on-the-grass breaks.

This approach, of course, is classically Western. Manipulate the environment; feel nature without even trying. As for me, I’m going to be looking for a more East-meets-West approach. I’ll try harder to quit checking my text messages and instead watch for rock bass jumping in the C&O Canal. Scratch and sniff some pine cones. Run my hands through the moss. Maybe even drink a little bark tea.

After all—yes, I am not a dog.

Contributing editor Florence Williams (@flowill (<https://twitter.com/flowill>)) is the author of Breasts: A Natural and Unnatural History (<http://www.amazon.com/Breasts-Natural-Unnatural-Florence-Williams/dp/0393063186>).

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