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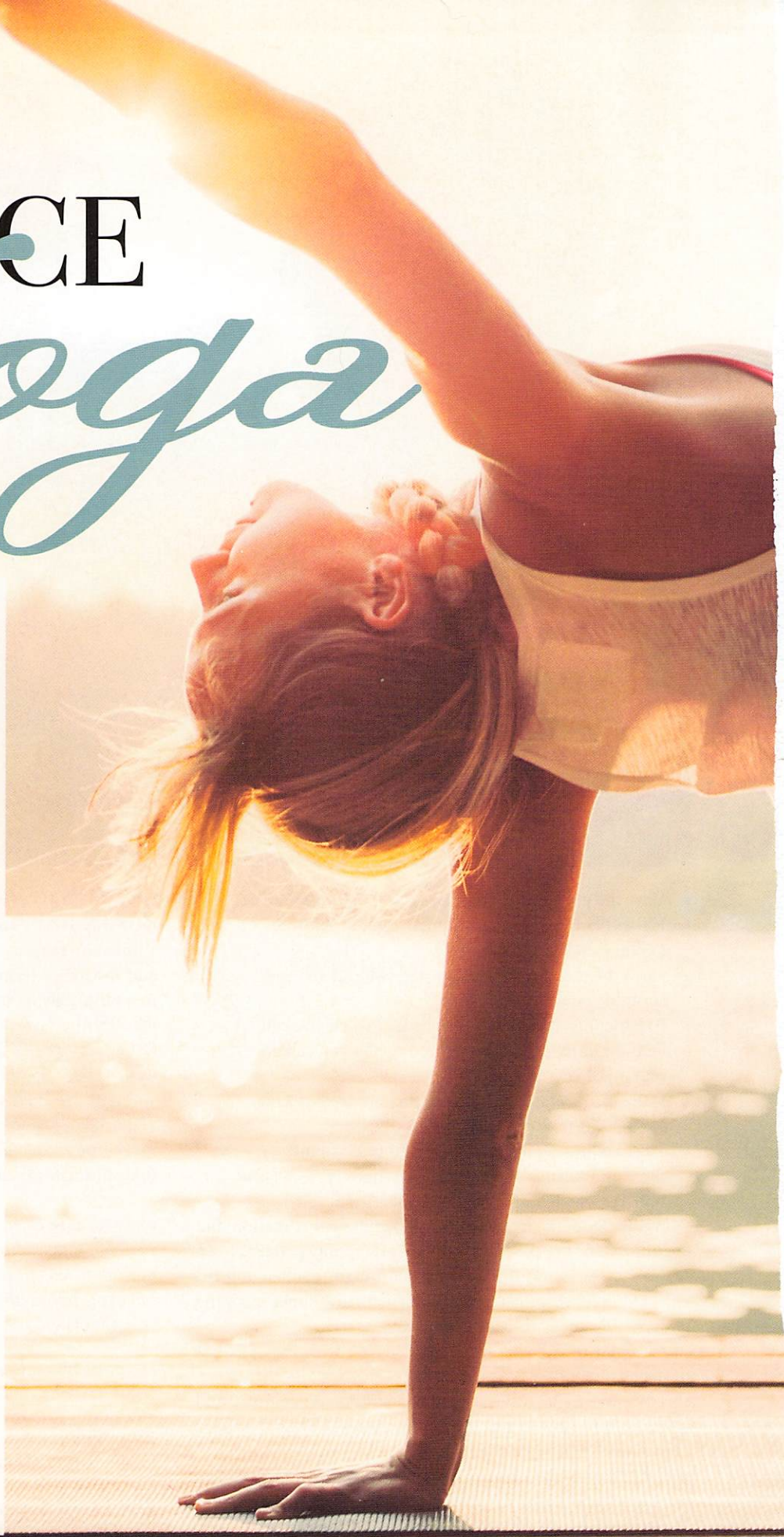
THE SCIENCE OF *Yoga*

By Shirley Archer, JD, MA

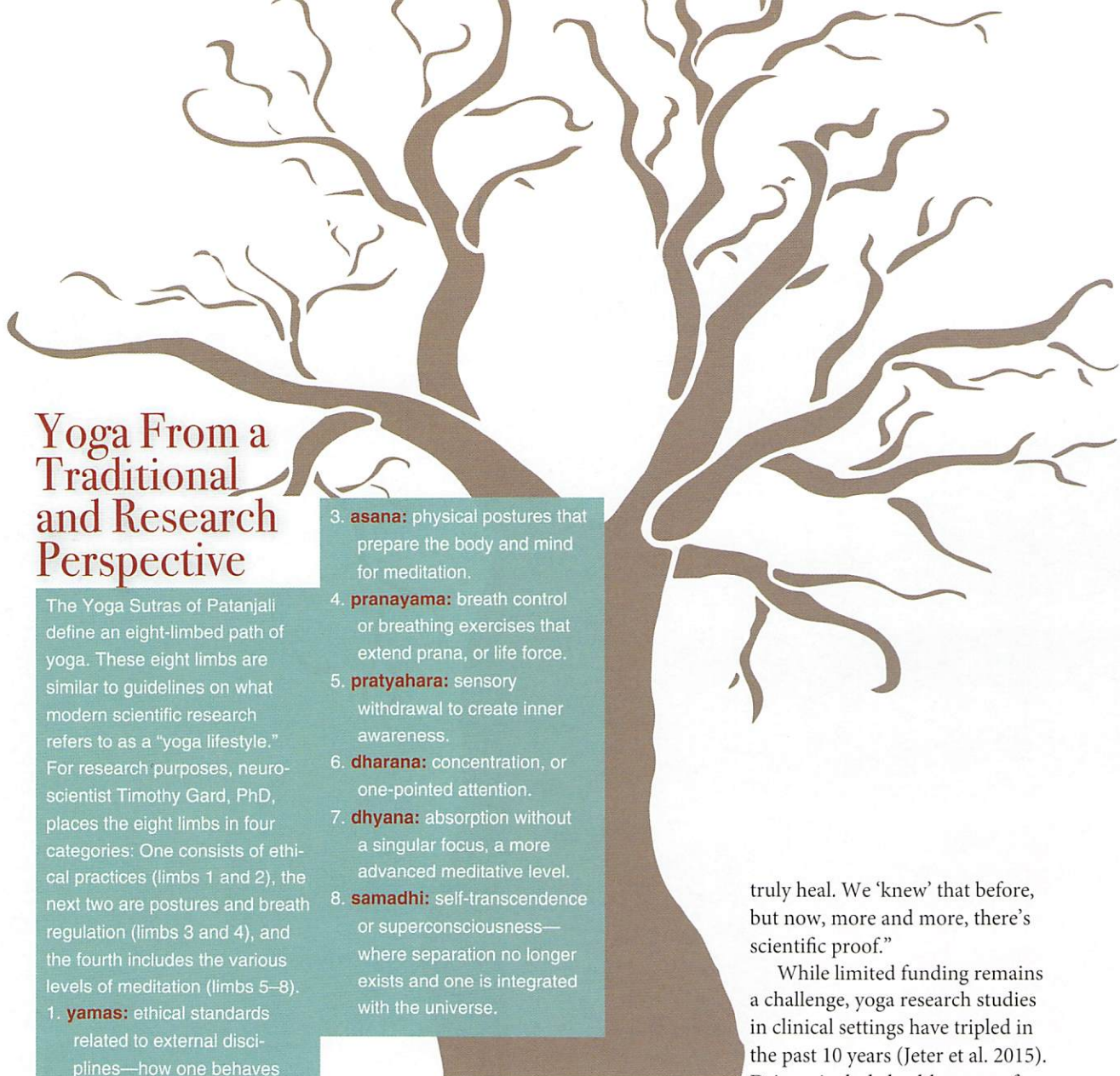
“Jane,” like many clients, tried yoga to reduce her stress and anxiety, but she often held her breath during triggering moments, taxing her to the point where she’d feel faint and need to lie on the floor. After taking yoga sessions with Nicole DeAvilla, RYT 500, of Kentfield, California, Jane immediately felt calmer, more grounded and more optimistic. DeAvilla, author of *The 2-Minute Yoga Solution: Fast and Easy Stress and Back Pain Relief for Anyone at Anytime* (Bush Street 2012), advised Jane to practice yoga daily so that she’d become more resilient and be able to apply specific breathing techniques as needed.

After a few weeks, Jane happily announced that the last time she was triggered, she remembered to do her breathing practice. Now she also practices her techniques when she wakes at night and can’t go back to sleep during stressful times, and she reports that she hasn’t had an incident of feeling faint in 6 months.

Like Jane (name changed for confidentiality), more people are seeking yoga practice for health benefits, and science is documenting its effectiveness. In the United States, 9.5% of adults—about 21 million people—reported that they practiced yoga as a complementary health approach



A growing body of research substantiates the many health benefits of integrative yoga practice.



Yoga From a Traditional and Research Perspective

The Yoga Sutras of Patanjali define an eight-limbed path of yoga. These eight limbs are similar to guidelines on what modern scientific research refers to as a “yoga lifestyle.” For research purposes, neuroscientist Timothy Gard, PhD, places the eight limbs in four categories: One consists of ethical practices (limbs 1 and 2), the next two are postures and breath regulation (limbs 3 and 4), and the fourth includes the various levels of meditation (limbs 5–8).

1. **yamas:** ethical standards related to external disciplines—how one behaves in relation to people and objects.
2. **niyamas:** ethical standards related to internal disciplines and spiritual observances.

in 2012 (Clarke et al. 2015). Yoga practitioners noted greater health benefits than adults who tried other complementary health practices. Reasons cited for doing yoga included wanting greater wellness, feeling better emotionally, exercising more, eating better, and cutting back on alcohol and cigarettes.

These objectives reveal a relationship between interest in yoga and a desire for healthy lifestyle habits (Stussman et al. 2015).

3. **asana:** physical postures that prepare the body and mind for meditation.
4. **pranayama:** breath control or breathing exercises that extend prana, or life force.
5. **pratyahara:** sensory withdrawal to create inner awareness.
6. **dharana:** concentration, or one-pointed attention.
7. **dhyana:** absorption without a singular focus, a more advanced meditative level.
8. **samadhi:** self-transcendence or superconsciousness—where separation no longer exists and one is integrated with the universe.

Jane is typical of the many people who look to yoga for health reasons, and ongoing research continues to reveal an array of associated health benefits. Here’s a snapshot of current research highlights and examples of practical applications.

YOGA RESEARCH HIGHLIGHTS

“What’s most exciting to me about research into yoga’s benefits is that there finally *is* research,” says Beth Shaw, founder and president of YogaFit® Training Systems Worldwide in New York City. “For years, no one was able or willing to spend money on studies. Now we know that yoga and meditation

truly heal. We ‘knew’ that before, but now, more and more, there’s scientific proof.”

While limited funding remains a challenge, yoga research studies in clinical settings have tripled in the past 10 years (Jeter et al. 2015). Drivers include healthcare professionals’ need to understand yoga’s effects; yoga community leaders’ desire to validate traditional practices; and, for those wanting to manage healthcare costs, an interest in identifying viable preventive self-care, stand-alone therapies, or adjunctive therapies that complement prescription medications.

A consistent definition of yoga is essential in order to discuss research. In a 2014 study, neuroscientist and lead study author Tim Gard, PhD, noted that most yoga research emphasizes the following four categories: ethics, postures, breath regulation and meditation (Gard et al. 2014) (see the sidebar “Yoga From a Traditional and Research Perspective”). For purposes of this article, therefore, we’re not looking

at *physical fitness* benefits, but rather at *overall health* benefits from integrated practice.

Lack of standardization in yoga research presents a challenge. Studies with less risk of bias include systematic reviews and randomized controlled trials (RCTs). However, yoga styles vary—an analysis of RCTs found 47 different styles (plus 30 yoga breathing techniques) among 312 RCTs (Cramer, Lauche & Dobos 2014). Not all studies identify the style used, and protocols vary in frequency and duration. Many studies include *all* elements of ethics, postures, breathing exercises and meditation, but that is not true in every case. Moreover, yoga is individualized and integrative, and RCTs focus on uniform treatments and specific endpoints. Therefore, RCT methodology limits the ability to evaluate individualized programs and broader healing outcomes—hallmarks of real-life yoga practice.

Against this backdrop are the following highlighted findings from peer-reviewed studies:

QUALITY OF LIFE

Yoga practice is associated with health-related quality of life [HRQOL] improvements. In general, practitioners report HRQOL improvements from yoga practice. “The improved sense of well-being [from yoga practice] is exciting because this yields greater program adherence,” says Amanda Frame, DNP, E-RYT 500, master trainer for YogaFit, from Evans, Georgia.

However, different practice components, such as meditation and postures, are associated with different benefits. In a cross-sectional analysis of 309 healthy adult survey respondents, people who practiced

community-based meditation and breathing exercises showed higher scores in mental-health life quality. On the other hand, practitioners with more years of postural practice, particularly in class settings, scored highest on physical aspects of HRQOL (Birdee, Ayala & Wallston 2017). More studies are needed to identify protocols and effects for specific populations, yoga styles and practice settings.

LOWER-BACK PAIN AND ARTHRITIS

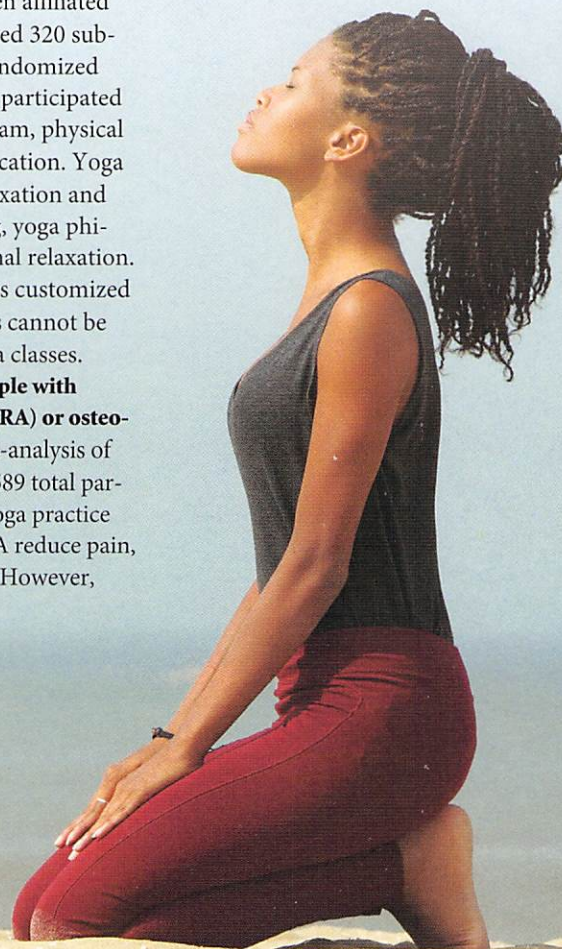
Yoga may be as effective as physical therapy for chronic lower-back pain [LBP]. The largest yoga and back-pain study to date showed that yoga is as effective for helping people manage mild to moderate chronic back pain as physical therapy (Saper et al. 2017). Boston Medical Center and Harvard University researchers and colleagues in seven affiliated health centers evaluated 320 subjects for 1 year in a randomized clinical trial. Subjects participated in either a yoga program, physical therapy or health education. Yoga practice included relaxation and meditation, breathing, yoga philosophy, poses and final relaxation. The yoga program was customized for LBP, so the results cannot be generalized to all yoga classes.

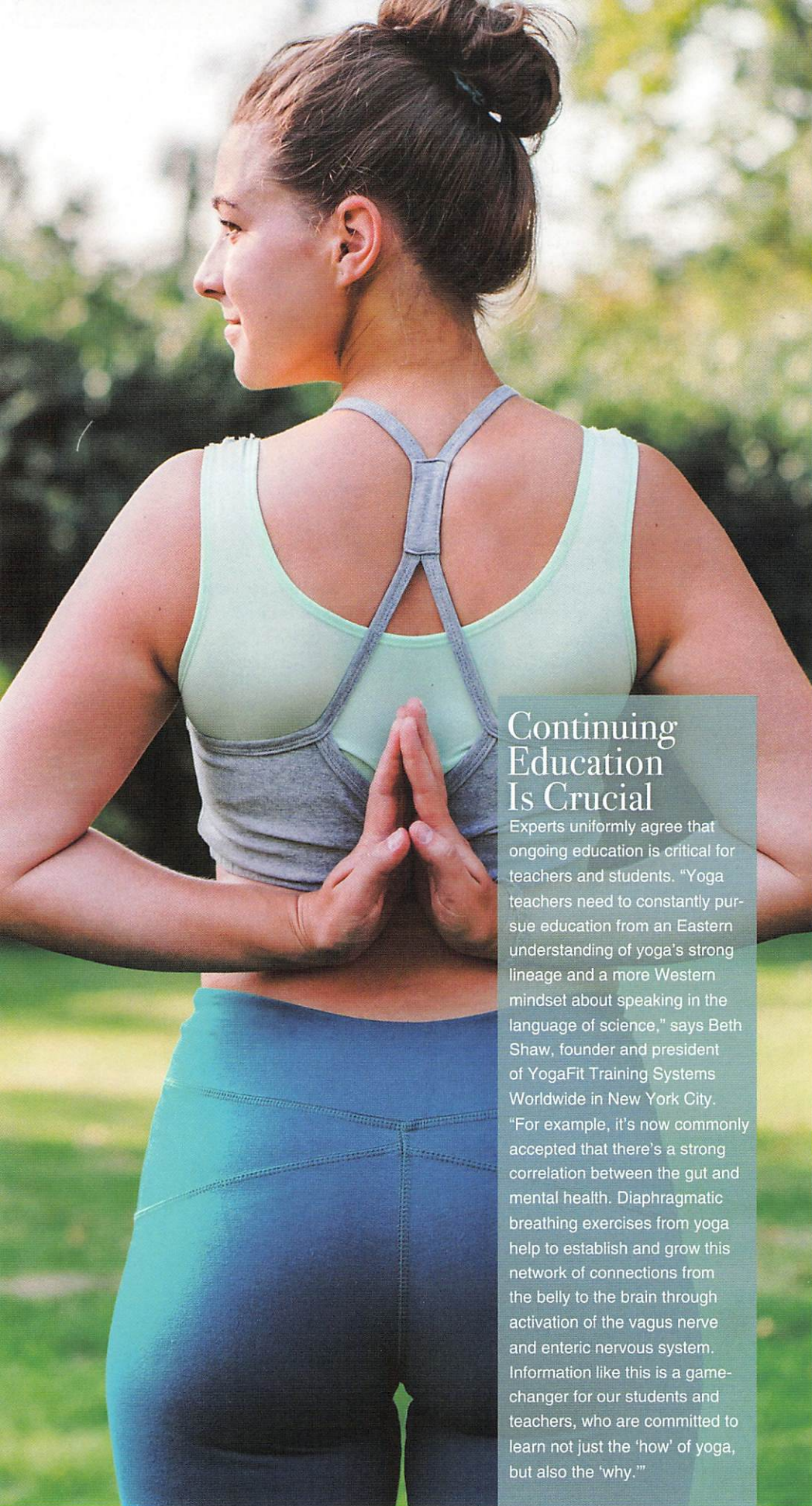
Yoga may help people with rheumatoid arthritis (RA) or osteoarthritis (OA). A meta-analysis of 12 clinical trials with 589 total participants found that yoga practice helped people with OA reduce pain, stiffness and swelling. However,

physical function and psychosocial well-being benefits could not be substantiated, given the diversity of outcome measures. Iyengar and hatha were the most frequently used yoga styles (Cheung, Park & Wyman 2016). The largest study of OA and RA found that yoga practice improved physical pain, general health, vitality, activities of daily living, balance, upper-body strength and mental health. Subjects still enjoyed the benefits 9 months after the program ended (Stephens 2017).

HEART DISEASE AND DIABETES

Yoga may reduce heart disease risks. “I’m very excited about the impact of pranayama on cardiovascular disease and hypertension,” says Ina Stephens, MD, associate professor of pediatrics and co-director of





Continuing Education Is Crucial

Experts uniformly agree that ongoing education is critical for teachers and students. "Yoga teachers need to constantly pursue education from an Eastern understanding of yoga's strong lineage and a more Western mindset about speaking in the language of science," says Beth Shaw, founder and president of YogaFit Training Systems Worldwide in New York City. "For example, it's now commonly accepted that there's a strong correlation between the gut and mental health. Diaphragmatic breathing exercises from yoga help to establish and grow this network of connections from the belly to the brain through activation of the vagus nerve and enteric nervous system. Information like this is a game-changer for our students and teachers, who are committed to learn not just the 'how' of yoga, but also the 'why.'"

the Medical Yoga Initiative at the University of Virginia Medical Center in Charlottesville, Virginia. Stephens, who is also an RYT 500 and an NASM-certified personal trainer, adds that this is an area with important potential. The American Heart Association says yoga practice, not to meet physical exercise requirements, but rather to increase physical, mental and emotional well-being, can be used to improve heart health as a preventive measure or after a cardiac event (AHA 2013).

Stephens notes that—likely because of yoga's effect on the autonomic nervous system, emotion regulation and chronic stress—numerous studies have found that practice (among diverse patients) led to improvements in blood pressure, lung capacity, respiratory function, heart rate, circulation and heart rate variability, among other biomarkers. The studies featured different yoga styles and included meditation, breathing, postures and, in some instances, lifestyle modifications, such as adopting a primarily plant-based diet or joining a supportive practice community (Stephens 2017). A practice community is sometimes known as *sangha*.

Yoga practice may help people with type 2 diabetes. A study review of yoga and people with type 2 diabetes found that yoga is effective in lowering fasting blood-glucose levels and can influence other clinical outcomes, such as glucose tolerance, insulin resistance, blood pressure and cholesterol levels. Twelve RCTs with a total of 864 patients were included in the review. Further studies are needed with longer durations, larger sample sizes, more rigorous methodology, and measurement of outcomes such as quality of life, overall survival, inflammatory mediators and immune cell function (among others), since aspects of yoga may affect these variables (Cui et al. 2017).

ANXIETY, DEPRESSION AND PTSD

Yoga practice may benefit those with anxiety, depression and/or posttraumatic stress disorder (PTSD). Yoga practice that includes breathing, movement and deep relaxation appears to modulate stress response systems and, as a result, helps people regulate stress and pain responses (Harvard Health Publications 2009). In a study summary published in the *Harvard Mental Health Letter*, authors noted that yoga practices have demonstrated mood improvements with reductions in perceived stress, depression and anxiety, as well as improvements in energy and quality of life for older adults, caregivers, breast cancer survivors and patients with epilepsy.

In an “evidence map” review conducted by the U.S. Department

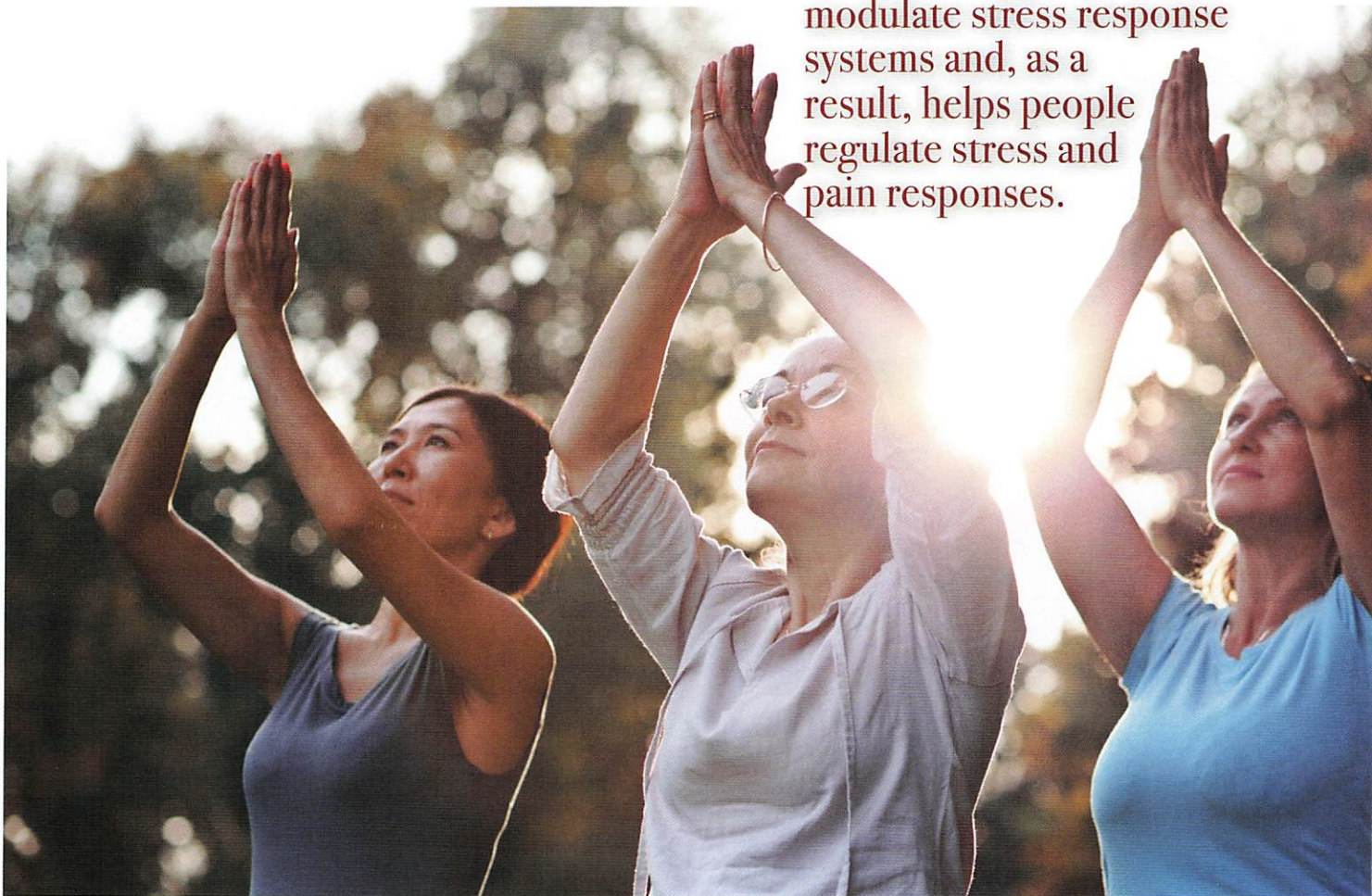
of Veterans Affairs, researchers concluded that yoga practice may improve short-term depressive symptoms, but more research is necessary for generalized anxiety disorders, panic disorders and PTSD. Review authors noted that RCTs suggested potential benefits, but the studies were small and lacked rigorous methodology. Very few adverse effects were reported, but those that did occur were related to advanced breathing techniques, meditation, headstand, shoulder stand, hot yoga, headache and eye issues, indicating the need for caution with inversions and any type of “forceful or competitive yoga” (Duan-Porter et al. 2016).

In another RCT involving people with depression, researchers found that those who attended a 90-minute Iyengar yoga class twice or three times a week experi-

enced significant improvement in mood and reduction of symptoms (Streeter et al. 2017). The class consisted of yoga postures, deep relaxation and *ujjayi* breathing practice, followed by 20 minutes of “coherent breathing”: a 6-second nasal inhalation and a 6-second exhalation through pursed lips for five complete breath cycles per minute.

“This study supports the use of a yoga and coherent breathing intervention in major depressive disorder in people who are not on antidepressants and in those who have been on a stable dose of antidepressants and have not achieved a resolution of their symptoms,”

Yoga practice that includes breathing, movement and deep relaxation appears to modulate stress response systems and, as a result, helps people regulate stress and pain responses.



said lead study author Chris Streeter, MD, associate professor of psychiatry at Boston University School of Medicine in Boston, in a Boston University Medical Center news release.

INFLAMMATION AND IMMUNITY

Yoga practice reduces inflammation and boosts immunity.

A growing body of research shows that people who regularly practice yoga exhibit decreases in inflammatory markers, increases in chemicals that fight inflammation, and higher levels of antibodies in the blood—all indicating immune system health (Stephens 2017). In an RCT of women with breast cancer, Stephens noted that those who practiced yoga for 12 weeks experienced less fatigue, fewer inflammatory markers and more vitality. This result persisted 6 months after the intervention.

Yoga practice positively affects gene expression, boosts telomere length and may affect longevity.

More research evidence is emerging about yoga's effect on gene expression and telomere length, which directly influence overall health and longevity. Gene expression refers to the process by which a gene's genetic code is "directed" to produce cell structures. Epigenetic research suggests that gene expression can be changed in ways that promote or undermine health without altering underlying DNA.

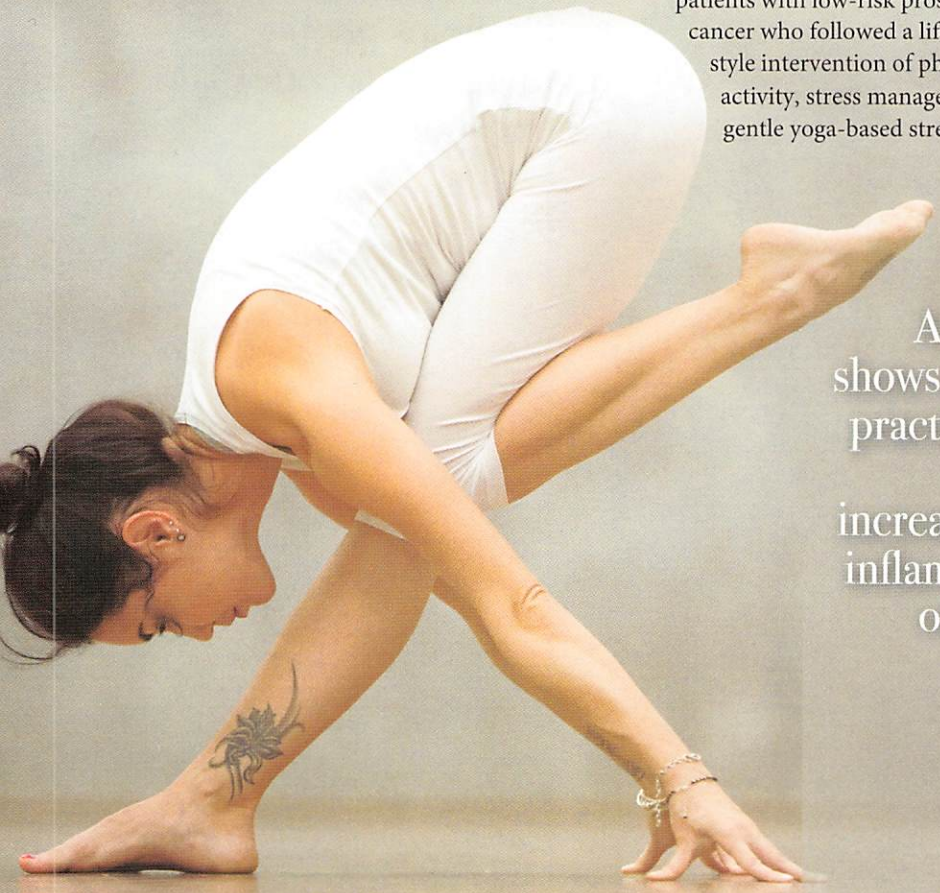
In a 2008 study that included integrative yoga lifestyle practice, researchers found that genes that promoted cancer were no longer active or had become less so, while genes that helped fight cancer were "switched on" (Ornish et al. 2008). That study, conducted by Dean Ornish, MD, founder of the Preventive Medicine Research Institute at the University of California, San Francisco, included patients with low-risk prostate cancer who followed a lifestyle intervention of physical activity, stress management, gentle yoga-based stretching,

postures, breathing, meditation, imagery, progressive relaxation, dietary changes and social support. These patients experienced changes in gene expression that positively affected cancer.

In a 2013 follow-up study, Ornish et al. found that adherence to the integrative lifestyle intervention was associated with increases in relative telomere length. Telomere length and telomere shortening are indicators of cellular aging. Longer telomeres are associated with fewer illnesses and longer life (Ornish et al. 2013).

BRAIN HEALTH

Yoga practice may protect and preserve brain health. More studies are documenting the benefits of regular yoga practice for brain preservation. A study comparing yoga practitioners with nonpractitioners found that regular practice may have neuroprotective effects against age-related whole-brain decline in gray matter. Brain changes indicated that years of practice progressively "tuned" the brain toward a parasympathetically driven mode and positive mood states (Villemure et al. 2015).



A growing body of research shows that people who regularly practice yoga exhibit decreases in inflammatory markers, increases in chemicals that fight inflammation, and higher levels of antibodies in the blood—all indicating immune system health.



Reported Benefits of Yoga Practice

In the 2012 National Health Interview Survey, 70% of yoga practitioners reported that they used yoga to “focus on the whole person—mind, body and spirit.” Additional reasons given for practicing yoga included the following:

- **General wellness.** The most common wellness-related reason for doing yoga was to promote health and prevent disease.
- **Mood improvement.** More than two-thirds of survey respondents reported that yoga, supplements and spinal manipulation made them feel better.

- **Increased physical activity.** Approximately two-thirds of yoga practitioners practiced yoga as a way to increase their regular exercise.
- **Improved eating habits.** About 42% of participants reported that yoga motivated them to eat better.
- **Stress reduction.** More than 80% of yoga enthusiasts reported that the discipline reduced stress.

Source: Stussman et al. 2015.

Another recent study showed that elderly female yoga practitioners who had trained a minimum of 8 years had greater thickness in the left prefrontal cortex, a brain region associated with attention and memory, compared with nonpractitioners and those with less experience (Afonso et al. 2017).

APPLYING SCIENCE FOR EFFECTIVE TEACHING

A quick research overview illustrates yoga’s potential power for both healing and health promotion. One of yoga’s strengths, however, is that it can be highly individualized. Below, experienced practitioners offer tips on how to integrate beneficial aspects of yoga into training sessions for diverse clients.

BREATHING PRACTICES, OR PRANAYAMA

“Emphasizing breathing is extremely important,” says Stephens. If you can help people connect their mind to their breath, no matter what they’re doing, it’s

the first step toward inner awareness, or *pratyahara*. “It helps people to slow down physiologically,” she says. “If you can teach someone to have a prolonged 5-count exhalation, it accesses the parasympathetic nervous system. Even in faster-paced vinyasa classes, concentrating and making sure that students have breath with movement will keep the nervous system in check.”

PRECISE ALIGNMENT

Doing a yoga pose incorrectly can cause problems, says DeAvilla. Studies with good outcomes note that precise alignment is critical. In a pilot study of women with incontinence, researchers who offered an Iyengar-based program (two 90-minute classes and one weekly home practice for 6 weeks) observed significantly decreased incontinence (Huang et al. 2014). Instructors emphasized precise alignment, mindfulness, prop use and pelvic-floor muscle awareness, rather than rapid cycling through postures. “The physics of how the

body works [varies with] each person; instructors need to respect and honor each [unique] body,” says Detroit-based YogaFit master trainer and physical and yoga therapist Brandi Bernard, DPT, E-RYT 500. Experts recommend individualized instruction, prop use, a noncompetitive atmosphere and knowledge of functional anatomy.

MINDFUL MOVEMENT

Experts agree that getting people to slow down can be challenging, but cultivating controlled, mindful movement that develops inner awareness and fosters the mind-body connection is essential. DeAvilla reminds students that traditional yoga takes one pose at a time. “I tell students when correcting them that we’re doing this so that we can do it 10 years from now. Fast is not necessarily ‘bad’—it’s just not what most people need.”

Kristine Kaoverii Weber, MA, E-RYT 500, creator of Subtle® Yoga in Asheville, North Carolina, agrees. “Slow movement builds resilience, interoception and vagal tone, helps



The American Heart Association says yoga practice, not to meet physical exercise requirements, but rather to increase physical, mental and emotional well-being, can be used to improve heart health as a preventive measure or after a cardiac event.

stimulate positive brain changes, and promotes oxytocin—the ‘tend and befriend’ biochemical,” she says. “Educate your students about the many benefits of slow movement.”

DEEP RELAXATION

“Rest is key to regeneration and integration,” says Stacy McCarthy, E-RYT 500, a meditation teacher in Rancho Santa Fe, California. “Savasana is truly part of what makes yoga yoga. Without the process of quieting the mind and going within, yoga asana [practice] becomes a glorified calisthenics class. To maintain the integrity of the tradition, yoga should be respected as a whole practice. If a student only has 35 minutes, offer a 2- to 3-minute savasana. Never skip it!”

“Ending an active class with a 5-minute restorative posture is a great way to take students into deep relaxation,” says Stephanie Adams, E-RYT 500, owner of Flow Yoga in Hood River, Oregon. “Simply roll a mat . . . and place it under the midthoracic area. If you have extra props for under the knees, and head and/or eye pillows, this can allow for more relaxation. Yoga nidra is another way to deeply relax the body and mind.”

MEDITATION

The science of meditation, which is a component of yoga, is significant and growing. Studies document benefits ranging from stronger immune systems, mood improvements and better concentration to sleep and pain management, lower blood pressure, and growth of both white and gray brain matter.

Suggested methods for introducing meditation to students include offering 2-minute initial practices and gradually increasing the time, teaching separate meditation classes, and offering meditation workshops. “I created the 2 Minute Yoga Solution because I had such a hard time getting people to practice,” says DeAvilla. “If I could get them to experience the benefits of even 2 minutes, that would excite them to want to learn and do more.”

“Begin each class with a simple breathing meditation to bring mindfulness to the practice from the start,” says Adams. “End class with a short guided meditation in savasana.”

COMMUNITY/GROUP SUPPORT, OR SANGHA

“To build community among my students, I created ‘burrito satsangs [gatherings],” shares DeAvilla. “I hold a potluck at my apartment, or sometimes a student volunteers a home. Everyone brings a favorite healthy dish, so we don’t impose on any person’s diet. This improves



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the class environment for everyone, as we learn about each other away from class. Yoga teachers can do many things to create a yoga lifestyle experience.”

INTEGRATED LIFESTYLE

Living an integrated lifestyle is considered part of what makes yoga beneficial. Instructors can help with this by educating students on how to take their practice off the mat and into their lives. “I created a full-day yoga retreat called ‘A Day of Namaste,’ in which I talk about mastering . . . how you eat, how you move and how you think,” says McCarthy. “We practice yoga and meditation, discuss proper nutrition and the benefits of eating a plant-based diet, and address yoga as a whole.”

ETHICS, VALUES, PURPOSEFUL LIVING

Yoga is rooted in a tradition of living a meaningful and purposeful life. A study review of life purpose as an “aim that stimulates goals, manages behavior and provides a sense of meaning” found that a strong sense of purpose may reduce

the risks of heart disease and early death and has been associated with better immune function and lower levels of salivary cortisol (Cohen, Bavishi & Rozanski 2015).

To introduce yoga values, McCarthy recommends creating “a focus for classes and providing educational resources for students to use off the mat, so that when they come to class, they’re ready to focus on whatever that class is [addressing].” Adams incorporates themes in the monthly newsletter and teaches them in classes. “One year, we featured one *yama* or *niyama* each month,” she says. “For example, instructors taught *ahimsa*, or nonharming, as a way to become more aware of the subtleties of body alignment to reduce injury risks.”

YOGA ON AND OFF THE MAT

Researchers are only beginning to discover the breadth and depth of yoga’s healing and health-promoting abilities. When yoga is understood in the context of lifestyle practice, it’s easy to see the challenge presented to modern

science to document its many benefits. “Evidence-based research is good . . . but it’s also important to consider that yoga practices, like alternate-nostril breathing, should do no harm,” says Shaw, adding, “Almost anyone can do simple, gentle movement and breathing.” With the potential to offer so much to so many, the future of yoga is bright. ■

Shirley Archer, JD, MA, E-RYT 200, is IDEA’s 2008 Fitness Instructor of the Year and mind-body spokesperson. She provides integrative training and mind-body resources to help people achieve health, happiness and optimal well-being. An award-winning author of 12 books, she is based in Los Angeles and Zürich. Find her on Twitter, Pinterest and Instagram (@shirleyarcher) or at www.shirleyarcher.com.

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Source: Stussman et al. 2015.

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