

HOW YOGA HELPS THE BRAIN

Shea E. Ferguson^{1*}, Sarah J. Short^{2,3}, Adrienne G. Huxtable⁴ and Courtney H. Guenther⁵

¹Department of Educational Studies, College of Education, University of South Carolina, Columbia, SC, United States

²Department of Educational Psychology, School of Education, University of Wisconsin-Madison, Madison, WI, United States

³Center for Healthy Minds, College of Letters and Science, University of Wisconsin-Madison, Madison, WI, United States

⁴Department of Human Physiology, University of Oregon, Eugene, OR, United States

⁵Department of Biology, College of Arts and Sciences, Winthrop University, Rock Hill, SC, United States

YOUNG REVIEWERS:

7TH GRADE

CHRISTINA

SEIX

ACADEMY

AGES: 12–13



Most people think about yoga in terms of its physical benefits, such as increased strength and flexibility, but yoga can also lead to positive changes in the brain. If you are in school, yoga may help you reduce stress and improve your attention—both in and out of the classroom. One of the best things about yoga is that it requires no equipment, so you can do it anywhere. Practicing yoga can help both your brain and body feel better.

YOGA HELPS THE BODY AND BRAIN

Yoga is a practice that originated in India thousands of years ago and Sanskrit is a language used in yoga. Yoga has many styles and definitions, but they all center on connecting the mind and the body. Generally, when yoga students are doing yoga, they focus on going through a series of movements and postures, and connecting their movements with their breathing. The yoga teacher helps students

learn how to move with their breath. Some movements occur while seated, some while on hands and knees, and others while standing. Some poses can even be done lying down.

Why is it important to practice yoga? Because there are so many benefits for both the body and the brain! Researchers have shown that a yoga practice can lead to changes in brain structure and function [1, 2], which may result in more positive emotional responses. If you are in school, it is possible that practicing yoga could help reduce your stress and improve your attention, both inside and outside of class. One of the best things about yoga is that you can do it anywhere, since it requires no equipment.

NEURONS

Brain cells with three main parts (axon, cell body, dendrites) that allow communication with other neurons and the rest of the body through chemical and electrical signals.

GRAY MATTER

Darker-colored brain matter that includes the cell bodies and dendrites of neurons, found in the outer regions of the brain.

WHITE MATTER

Lighter-colored brain matter that includes the myelinated axons of neurons, found in the inner regions of the brain.

HIPPOCAMPUS

An area of the brain important for learning and memory.

PREFRONTAL CORTEX

An area of the brain important for understanding and regulating emotions and decision making.

AMYGDALA

An area of the brain important for many emotions, including fear.

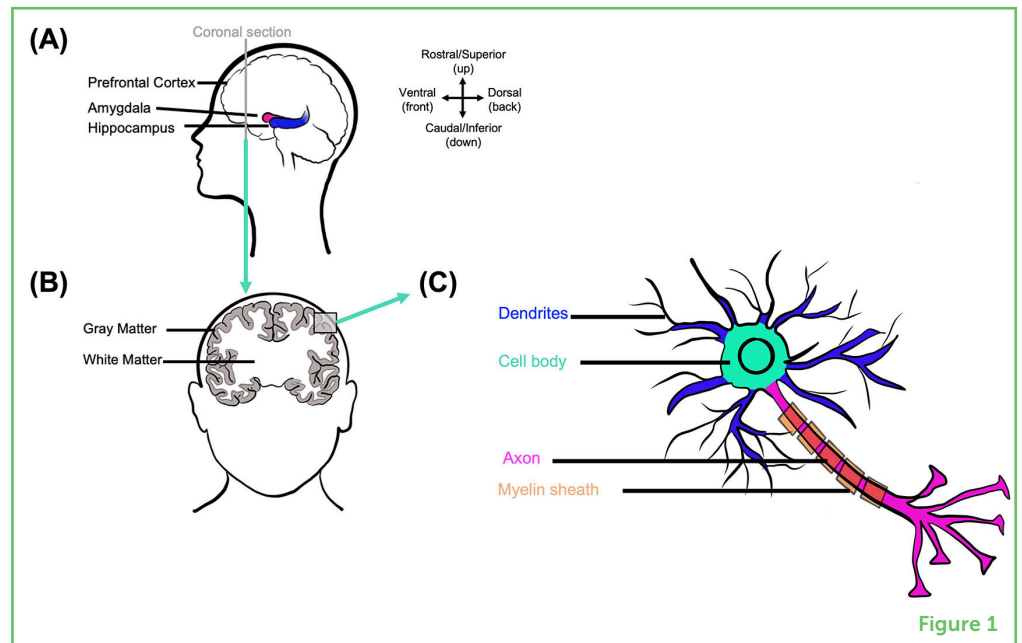
INTRODUCTION TO BRAIN ANATOMY

To understand how yoga impacts the brain, you must first understand the key components of the brain. The brain is made up of cells called **neurons**. Neurons generally have three main parts: dendrites, a cell body, and an axon (Figure 1C). Each part of the neuron has a special role, and together they allow neurons to communicate with each other through chemical and electrical signals. These signals send information throughout the brain and the body, controlling all of your daily activities, like breathing, walking, and learning. The dendrites receive information from other neurons and pass this information to the cell body, which is the control center of the neuron. The cell body then sends information along its axon to communicate with other neurons. When looking at the brain as a whole, the various parts of neurons make up two kinds of brain tissue, called **gray matter** and **white matter** (Figure 1B). Gray matter, generally found along the outer edges of the brain, includes cell bodies and dendrites. White matter, which is generally found in the inner parts of the brain, includes axons coated with a whiteish substance called myelin, which allows the signals between neurons to move very quickly.

The brain is made up of various regions that all work together, with neurons from one region communicating with neurons in many other regions. This communication between neurons in different regions across the brain is what allows you to do everything you do every day. Some important brain regions for learning and emotions include the **hippocampus**, **prefrontal cortex**, and **amygdala** (Figure 1A). The hippocampus is like a memory bank, and it plays an important role in almost everything you learn. The prefrontal cortex is important for understanding and regulating your emotions, and it helps you plan and make decisions throughout the day. The amygdala is important for many of the emotions you experience, and it is most well-known for its role in fear. These brain regions, and many more, are very important to your wellbeing because they work together to help you feel, process, and act on your emotions.

Figure 1

(A) The brain has a number of important regions that work together, including the hippocampus (memory), prefrontal cortex (emotions and decision making), and amygdala (emotions and fear). (B) A section of the brain sliced down the middle [along the light gray line in (A), called a coronal section], showing gray matter in the outer brain regions and white matter in the inner regions. (C) A neuron with dendrites, a cell body, and an axon coated with myelin.



YOGA AND THE BRAIN

When most people think about yoga, they think about how it can help them feel better physically—and there is research to support this. There is also research to suggest that yoga can help you mentally. Because yoga engages various brain areas that are important for regulating emotions and calming the thoughts, yoga may help with anxiety, stress, emotion regulation, and overall wellbeing [1]. Research on how yoga affects the brain is new and evolving, but there are promising studies showing yoga's positive effects on the brain [2]. Using special imaging machines called functional magnetic resonance imaging (fMRI) or **magnetic resonance imaging** (MRI) scanners to look at the brains of yoga practitioners (for more information on how MRI works, see [this Frontiers for Young Minds article](#)), scientists found that yoga may benefit the brain as we get older. MRI machines let scientists take detailed pictures of the brain and measure the blood oxygenation levels to see what areas of the brain are **active**. As we age, the amount of gray matter (cell bodies and dendrites) declines, but scientists found that the loss of gray matter was slowed in people who did yoga [1, 2]. Researchers think this might happen because practicing yoga may lead to physiological changes that calm the nervous system [1, 2]. Additionally, practicing yoga was associated with increased gray matter in the hippocampus, a brain region important for learning and memory, and there is some evidence to suggest that yoga practice might improve memory [1, 2]. Yoga-related brain changes have also been found in the prefrontal cortex and amygdala, brain regions important for emotions [1]. More research is still needed to better understand the mechanisms behind these yoga-related changes in the brain.

MAGNETIC RESONANCE IMAGING

An imaging technology that helps scientist look at the brain by taking detailed three-dimensional pictures of the brain and measure the blood oxygenation levels to see what areas of the brain are active.

SOCIAL-EMOTIONAL LEARNING

The process of developing skills (self-awareness, self-management, social awareness, relationship skills, and responsible decision-making) that help you manage your emotions and build strong relationships.

YOGA IN SCHOOLS

Because of the benefits yoga can have on the brain and body, some K–12 schools are now teaching yoga to improve the wellbeing of their students. Yoga is one way to improve **social-emotional learning** (SEL). The goal of SEL is to help students develop skills important for classroom learning and beyond. Through SEL activities, students learn self-management, self-awareness, social awareness, relationship skills, and responsible decision making [3]. These skills can help students build better relationships with peers, help them learn how to cope with challenges, and help them to make more positive choices, both in and out of school.

Research examining yoga programs in schools is still new, but some schools have incorporated yoga into classroom activities or after-school programs. Results indicate that students who practiced yoga participated more in class and had increased attention and concentration. Some students' grades even increased. On the physical side, yoga also helped to increase balance and coordination. Students are not the only ones to benefit from yoga in schools—teachers can, too! Teachers who did yoga were less stressed out and felt more cheerful [3].

A YOGA SEQUENCE TO TRY

So, the next time you are feeling nervous, sad, or distracted, try practicing yoga! Here is a yoga sequence that you can follow at home or at school (Figure 2, Sanskrit is in parentheses). Better yet, practice with your friends and you all can benefit! Remember that yoga is about moving *and* breathing—so do not forget to focus on your breathing as you move through these poses.

Child's pose (Balasana): With your knees bent, gently bring your chest and head to rest on the floor, by folding forward. Allow your hips to rest on your heels if possible. Stretch your arms out in front and lengthen your spine. Take five deep breaths.

Cat/Cow (Bitilasana Marjaryasana): Come to your hands and knees, keeping your knees below your hips and your hands below your shoulders. As you inhale, gently lift your head and hips toward the sky, and as you exhale, arch your back and tuck your chin toward your chest. Repeat for five deep breaths.

Balance (Dandayamana Bharmanasana): From your hands and knees, extend your left leg back, hovering it in the air at hip height, and extend your right arm out in front of you at shoulder height. Balance for five deep breaths.

Figure 2

Try this simple yoga sequence the next time you feel sad, stressed out, or distracted. Do not forget to focus on your breathing! (Note: before beginning any physical activity, it may be helpful to discuss your options with a trusted medical professional. If physical movement is not available for you, you can focus on your breathing while sitting or lying down comfortably).

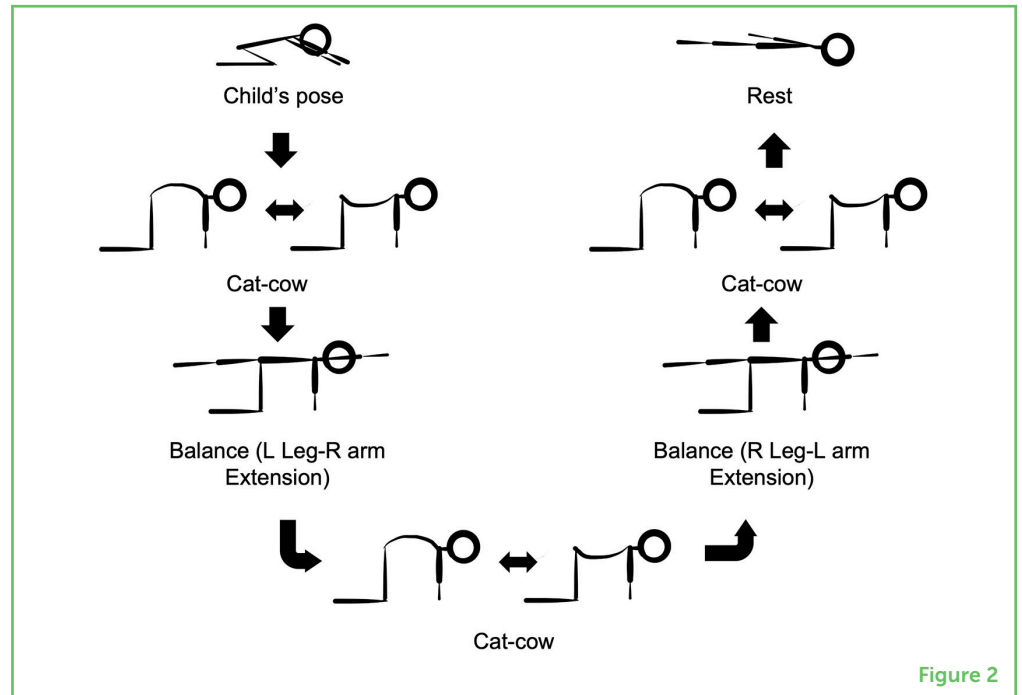


Figure 2

Cat/Cow (Bitilasana Marjaryasana): Repeat the instructions above for five deep breaths.

Balance (Dandayamana Bharmanasana): From your hands and knees, extend your right leg back, hovering it in the air at hip height, and extend your left arm out in front of you at shoulder height. Balance for five deep breaths.

Cat/Cow (Bitilasana Marjaryasana): Repeat the instructions above for five deep breaths.

Rest (Savasana): Lie on your back with your legs stretched out and your arms resting away from your sides, palms facing up. Gently close your eyes or gaze at a single spot on the ceiling. Take five deep breaths.

Conclusion: Through coordinated breath and body movements early research has shown that yoga can help you feel better and lead to positive changes in both your body and brain. Yoga can help you physically get stronger or help support your social-emotional learning and you can do it both in school and out of school!

REFERENCES

- Gothe, N. P., Khan, I., Hayes, J., Erlenbach, E., and Damoiseaux, J. S. 2019. Yoga effects on brain health: a systematic review of the current literature. *Brain Plast.* 5:105–22. doi: 10.3233/BPL-190084
- Villemure, C., Ceko, M., Cotton, V. A., and Bushnell, M. C. 2015. Neuroprotective effects of yoga practice: age-, experience-, and frequency-dependent plasticity.

Front. Hum. Neurosci. 9:281. doi: 10.3389/fnhum.2015.00281

3. Khalsa, S. B., and Butzer, B. 2016. Yoga in school settings: a research review. *Ann. N. Y. Acad. Sci.* 1373:45–55. doi: 10.1111/nyas.13025

SUBMITTED: 29 April 2022; **ACCEPTED:** 10 July 2023;

PUBLISHED ONLINE: 03 August 2023.

EDITOR: Sabine Kastner, Princeton University, United States

SCIENCE MENTORS: Patricia Maria Hoyos

CITATION: Ferguson SE, Short SJ, Huxtable AG and Guenther CH (2023) How Yoga Helps the Brain. *Front. Young Minds* 11:932145. doi: 10.3389/frym.2023.932145

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

COPYRIGHT © 2023 Ferguson, Short, Huxtable and Guenther. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

YOUNG REVIEWERS

7TH GRADE CHRISTINA SEIX ACADEMY, AGES: 12–13

Christina Seix Academy class of 2024 is a group of 19 energetic, ambitious and inventive adolescents who have a natural inclination to science and a love for cutting edge concepts that combine education with practical application. Being a part of the peer review process not only enhanced their understanding of neurological processes, but also expanded their knowledge of the scope of their scientific influence, which is in keeping with the independent school's mantra; "From potential to achievement."

AUTHORS

SHEA E. FERGUSON

Shea Ferguson is a Ph.D. student in educational psychology and research at the University of South Carolina and a graduate research assistant for the Child Development Research Center. She received her 200-hour yoga instructor certification from Y2 Yoga in August 2021. She continues to collaborate with Dr. Courtney Guenther on topics relating to mindfulness. *sferguson@sc.edu



**SARAH J. SHORT**

Dr. Sarah Short is an assistant professor and the Dorothy King chair in educational psychology and a faculty member for the Center for Healthy Minds at the University of Wisconsin. She received her Ph.D. in biological psychology and neuroscience and completed a postdoctoral fellowship in developmental cognitive neuroscience. She currently studies the impact of poverty on early child brain development and recently developed a parent-child mindfulness-based training program. She has authored several peer-reviewed publications on related topics: <https://www.ncbi.nlm.nih.gov/myncbi/1VKjUlwbltokv/bibliography/public/>.

**ADRIANNE G. HUXTABLE**

Dr. Adrienne Huxtable is an associate professor in the Department of Human Physiology at the University of Oregon. She received her Ph.D. in physiology at the University of Alberta and completed a postdoctoral fellowship in respiratory neurophysiology at the University of Wisconsin-Madison. She currently studies the neural control of breathing, with a specific focus on how early life stressors (such as inflammation and opioids) undermine breathing. She has authored several peer-reviewed publications on related topics: <https://huxtable.uoregon.edu/publications/>.

**COURTNEY H. GUENTHER**

Dr. Courtney Guenther received her Ph.D. in neuroscience at the University of Wisconsin-Madison and is a 200-hour Yoga Alliance certified yoga teacher. As an assistant professor in the Department of Biology at Winthrop University, she studied the use of mindfulness, yoga, and meditation to reduce stress and promote wellbeing in college students. Her most recent publication was with Dr. Sarah Short on PC-MBT: <https://journals.sagepub.com/doi/full/10.1177/2515690X211002145>.