

Humanities Seminars Program
The Ever-Changing Brain
Fall 2018

Instructor:

Leslie P. Tolbert, Ph.D., Regents' Professor Emerita
Department of Neuroscience
Gould-Simpson Building, Rm. 636
University of Arizona
tolbert@email.arizona.edu

Course time and dates:

9:00 – 11:00 am and 2:00 – 4:00 pm on Nov. 8, 15, and 29, and Dec. 6 and 13

Summary:

The human brain, guiding our every thought and action, is as complex as anything humans have ever attempted to explore and understand. Its almost unimaginable complexity arises from minute interconnections between tens of billions of brain cells. If we could map every connection between the nerve cells, would we understand how the brain works? Years ago, scientists might have said yes. But today it is clear that such knowledge would provide only the bare foundation for understanding, because those interconnections are changing every moment of our lives. They are recording our experiences, our emotions, our plans for the future – and they are constantly repairing disruption and injury. Evidence is mounting that intellectual challenge, social engagement, and regular physical activity can have a profound positive impact on our lives as we develop and as we age. Why? Because they influence the ongoing changes, or “plasticity,” in our ever-changing brains. In this course, we will examine the recent revolution in our concepts of brain function that is providing a new framework for trying to understand our brains. We will look at neuroscience research projects currently being mounted under the national BRAIN initiative and consider what might come next in brain research.

Recommended reading and viewing:

- *(available for optional purchase)* **The Brain: The Story of You**, by David Eagleman. Vintage Books Division of Penguin Random House Publishers, 2015.
- *(available for optional purchase)* **The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science**, by Norman Doidge, M.D. Penguin Books, 2007.

- *(available for optional purchase)* **Phantoms in the Brain: Probing the Mysteries of the Human Mind**, by V.S. Ramachandran, M.D., Ph.D., and Sandra Blakeslee. HarperCollins Publishers, 1999.
- **Patient H69**, by Vanessa Potter. Bloomsbury Sigma, 2017.
- **The River of Consciousness**, by Oliver Sacks, M.D. Alfred A. Knopf, 2017.
- “Rethinking the brain: How the songs of canaries upset a fundamental principle of science,” by Michael Specter. The New Yorker, July 23, 2001. Available at <https://www.msu.edu/course/psy/401/Readings/WK6.Supplement%20-%20New%20Yorker%20Article.pdf> .
- “The challenge of connecting the dots in the B.R.A.I.N.,” by Devor et al. Neuron, Vol. 80, pp. 270-274, October 16, 2013. Available at http://ac.els-cdn.com/S0896627313008064/1-s2.0-S0896627313008064-main.pdf?tid=eba472e8-1e8c-11e5-8f00-0000aab0f02&acdnat=1435602810_e1dc4f2fce233701ea3fd1737ef76c7d .
- An excellent TED talk by David Eagleman, on “Sensory substitution,” in which he describes the VEST technology he mentions in his book: <https://eagleman.com/research/sensory-substitution>
- Detailed, up-to-date description of the BRAIN initiative, including mission, approaches being used, and achievements to date, available at <http://www.braininitiative.org/> . One particular story is in video format at: <http://www.nature.com/news/crumb-of-mouse-brain-reconstructed-in-full-detail-1.18105>
- Two interviews of reporter Miles O’Brien, who lost an arm to injury: PBS interview just 3 weeks after losing his arm at <http://video.pbs.org/widget/partnerplayer/2365195775/?start=0&end=0&chapterbar=false&endscreen=false&topbar=true&autoplay=false> . CNN Special Report after further recovery, “Miles O’Brien: A Life Lost and Found,” at https://www.youtube.com/watch?feature=player_detailpage&v=mcPiBgXty8A .

Weekly Schedule

Week 1—Nov. 8: How do we approach brain science?

- Opening question for discussion: Why study the brain??
- How do we approach brain science? What are the basic issues neuroscientists face as we “map” brain circuits in health and disease?
- A crash course in neurobiology: Basic physical layout of our brains and fundamental cellular concepts, from neurons and synapses to neural circuits.

Optional preparation for next week: Read the New Yorker article by Michael Specter, the Devor et al. article published in Neuron, and Chapters 1 and 2 of **The Brain: The Story of You**.

Week 2—Nov. 15: The national BRAIN initiative and brain “plasticity”

- Define brain plasticity. What roles does it play in the developing brain? in the mature brain? What is exciting about the finding that new neurons are continually born throughout life?
- Review the basic plan of organization of the human brain, and take a glimpse into some of the exciting research being done under President Obama’s expansive BRAIN (Brain Research through Advancing Innovative Neurotechnologies) initiative. What will the BRAIN initiative accomplish? How far will it take us in our quest to understand the brain?
- Introduce V.S. Ramachandran as an early adopter of the revolutionary notion that plasticity is an underlying theme for many neurological impairments.

Optional preparation for next week: Read Chapters 4 and 5 of **The Brain: The Story of You** and Chapters 1-5 of **Phantoms in the Brain**. (You might also enjoy Chapter 12.)

Week 3—Nov. 29: Plasticity-based treatments for brain disorders

- Review details of organization of the neural pathways for visual and somatosensory inputs.
- Discuss Ramachandran’s explorations into plasticity-based treatments for such complex disorders as phantom limb pain, visual hallucinations, and syndromes in which patients are unaware of – and disown – half of their bodies.
- Test Ramachandran’s mirror box yourself!

Optional preparation for next week: Read chapters 1, 3, 7, 8, and 10 of **The Brain That Changes Itself** and Chapter 6 of **The Brain: The Story of You**. Watch David Eagleman’s TED talk at <https://eagleman.com/research/sensory-substitution> .

Week 4—Dec. 6: “More than the sum of its parts”

- David Eagleman and Norman Doidge review recent research on how brain circuits can be redesigned not only for repair but also for enhanced cognitive abilities. What is the evidence behind their ideas? Would it be possible to go too far?
- “More than the sum of its parts:” Doidge guides our discussion of how the brain’s complexity and plasticity have unforeseen implications for cognition and cognitive disorders.

Preparation for next week: Watch the Miles O’Brien video(s) and read Chapter 5 (and Chapter 6, if you haven’t read it already) of **The Brain: The Story of You**. Also, explore the extensive braininitiative.org website, and read the update on B.R.A.I.N. activities from January 2015. See more detail on one study in a video at <http://www.nature.com/news/crumb-of-mouse-brain-reconstructed-in-full-detail-1.18105> .

Week 5—Dec. 13: Where do we go from here?

- How is reporter Miles O’Brien harnessing brain plasticity as he adapts to life without his left arm?
- What are the most exciting developments to emerge from the BRAIN initiative in its first years? What is the promise for the future?
- What can we say about what makes humans such social beings? Are our brains “wired” for social interaction?
- Where do we go from here?? How does your new understanding of the brain shape your feelings about brain research?
- Will your understanding of brain plasticity change your view of yourself or change your lifestyle?