NIE ACTIVITY

Science MATTERS! ... IN CONNECTICUT

Stem Cell Therapy for Treating Epilepsy

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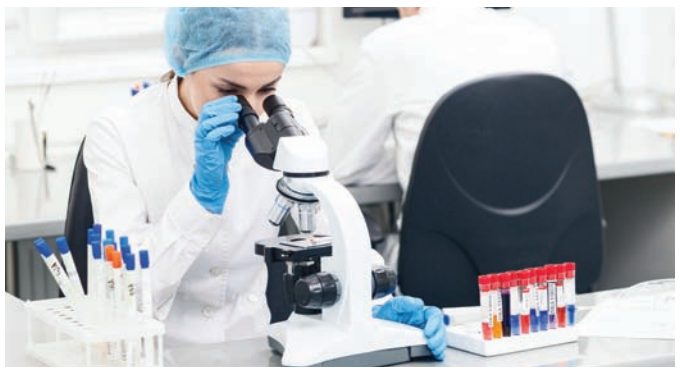
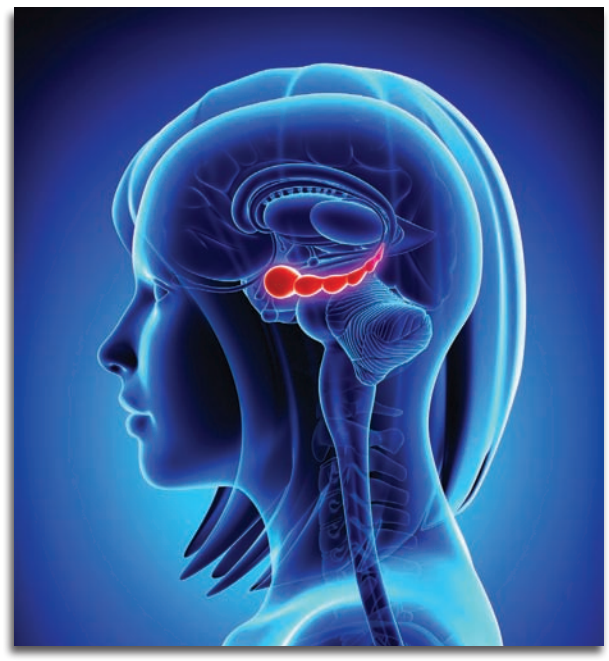
Science Matters! is a series presented in collaboration with the Connecticut Academy of Science and Engineering. For more information, visit www.ctcase.org or call 860.571.7143.



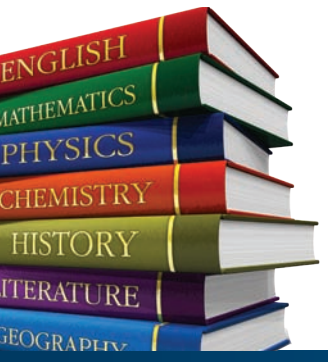
Neuroscientists around the world are fascinated by the incredible complexity of the human brain. While the brain's structures and functions are not completely deciphered, many scientists are working on finding treatments for brain disorders. Epilepsy is a brain disorder characterized by repeated episodes of convulsions or loss of consciousness. These episodes are caused by unusual electrical activity in the brain. Many patients with epilepsy control their seizures with medications and live relatively normal lives. However, for nearly a third, anti-convulsant medications lose their effectiveness, making epilepsy especially difficult to treat. Epilepsy affecting the temporal lobes of the brain is called temporal lobe epilepsy. Seizures in this region affect learning, mood, or memory formation. Temporal lobe epilepsy has many different causes, including genetic mutations, damage caused by prolonged high fevers in infancy, traumatic brain injuries such as can occur from car or bicycle accidents and concussions.

Neuroscientists have developed animal models of epilepsy in laboratory rodents to understand how seizures alter a part of the temporal lobes called the **hippocampus**. As the rodent and human hippocampus share many basic properties, new treatments for epilepsy can be studied in rodents to make safer and more effective therapies for patients. The hippocampus is required for us to learn and form new memories. Unlike some other brain regions, which can be surgically removed to control seizures without causing cognitive or behavioral impairments, removal of both hippocampi is never done, as this would result in permanent amnesia —the inability to form new memories.

Studies in rodent models of temporal lobe epilepsy suggest that the hippocampus rewires after injury and forms dysfunctional and maladaptive new neural connections. The newly rewired brain circuits tend to be hyperexcitable. Neuroscientists are testing new drugs to try to prevent rewiring and are exploring **stem cell** therapies to attempt to repair hippocampal damage. Recently scientist discovered how to induce normal adult skin cells to form embryonic cells called induced pluripotent stem cells, which can be grown in sterile tissue cultures and directed from this immature state to become mature cells, including heart, muscle, and brain cells, or **neurons**. These advances have opened an exciting new field called regenerative medicine that focuses on developing safer ways to repair brain damage with neural stem cells for treating patients with severe uncontrolled epilepsy or forms of neurodegenerative diseases.



SKILLS AND KNOWLEDGE



Neuroscientists are trained in a variety of scientific fields including biology, chemistry, psychology, physics, mathematics, engineering and medicine. Measuring brain activity and studying epilepsy requires knowledge of electricity and it is helpful to have training in computers, computer programming, and statistical methods. Studying stem cells requires advanced training in fields of cell biology and genetics. If you are interested in the field of neuroscience, you will also want to take undergraduate classes in neuroscience and behavior.

Meet the Scientist

I am a Professor of Biology with a PhD in neuroscience at Wesleyan University. In my laboratory at Wesleyan University, we study stem cell based therapies for temporal lobe epilepsy. Additionally, I teach courses in neuroscience and behavior. I first became interested in neuroscience in my high school biology classes. In college, I was fascinated by the ability of some animals, including fish and frogs, to regenerate parts of their visual systems after injury and studied regeneration in a laboratory. I also spent several summers studying monkeys in the wild and worked at the Boston Museum of Science. As an undergraduate at Mount Holyoke College, I majored in neuroscience and behavior and took science classes in the fields of psychology, biology, chemistry, math, and physics.

WORDS to know

Neuroscientist: a scientist with specialized knowledge in the field of neuroscience, the branch of biology that deals with the physiology, biochemistry, anatomy and molecular biology of neurons and neural circuits.

Hippocampus: a region in the brain that controls memory and emotion

Neurons: specialized cells in the brain that transmit electrical and chemical signals Seizures: surges of electrical activity in the brain that disrupt behavior, consciousness, and cognition

Stem Cells: an undifferentiated cell that ultimately can generate, through cell division, more stem cells or cells that differentiate into the adult tissues of the body and brain.

Hyperlinks:

Epilepsy (Brain Facts): https://sfn.org/brainfacts2/diseases-and-disorders/epilepsy
Stem Cell Information (National Institutes of Health): https://stemcells.nih.gov/
Brain Facts Book (from the Society for Neuroscience): https://sfn.org/BrainFacts/About-Neuroscience/Brain-Facts-book

NIE NEWS IN EDUCATION

For Students and Teachers Making Curriculum Connections, see the following:

Connecticut State Department of Education (CSDE) - Common Core State Standards (CCSS): Mathematics

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others
- CCSS.Math.Practice.MP5 Use appropriate tools strategically

CSDE - Next Generation Science Standards: Scientific and Engineering Practices

- Asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using Mathematics and computational thinking; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information.