



THE “CREATURES” IN YOUR HEAD

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YOUNG REVIEWERS:



AOIFE
AGE: 9



LAURA
AGE: 9

BRAIN

The organ inside of our head that is made up of billions of neurons and glial cells.

Imagine an overgrown rainforest full of all kinds of different creatures. That is exactly how I want you to picture your brain. In your dense and lively brain-jungle, the billions of trees are called neurons and, for every neuron-tree in your brain, there are one or more mystical jungle-creatures. Some of these creatures wrap tightly around the tree trunks, while others nurture the trees’ leaves and hug their roots. A special kind of dynamic jungle-creature eats damaged branches and keeps intruders away. These creatures are all called glial cells and, without them, your brain-jungle would collapse. Let us explore this remarkable jungle, to learn more about these astonishing glial-creatures and how we can observe them.

THE JUNGLE IN YOUR HEAD

You might have heard it said that your **brain** is like a computer [1]. This is a good way to explain how your brain works, but, if you could actually travel inside of your head, you would find yourself in a vibrant jungle full of creatures beyond your wildest imagination. In fact, it would look nothing like a computer in there! Your brain is a complex arrangement of billions of **cells** called **neurons** that

CELLS

The basic building blocks of all living organisms.

NEURONS

Special kinds of cells called nerve cells that form networks within the brain.

MICROSCOPES

Instruments used to magnify microscopically small objects, such as cells, which we otherwise would not be able to see.

GLIAL CELLS

The cells that live together with the neurons and whose main job is to protect and support the neurons.

each look like a tree that you might find in the jungle. Most of the neuron-trees in your brain-jungle have long trunks, beautiful widespread branches, and extensive systems of roots. But there is much more to your brain-jungle than your neuron-trees. Just as real rainforests are full of amazing animals like spider monkeys, tree frogs, and tarantulas, your brain-jungle contains mesmerizing “creatures” as well. In this article, I will introduce some of the creatures that inhabit your brain-jungle, describe how they are observed in the laboratory, and explain why they are so important for the daily functioning and health of your brain.

EXPLORING THE BRAIN-JUNGLE

If you were going on an expedition into a real rainforest, like the Amazon in South America, to study the animals living there, you would bring binoculars and cameras. But how would you study the creatures in the brain-jungle? Since the neuron-trees and the other jungle-creatures are microscopically small, scientists use **microscopes** instead of binoculars to study them. The brain samples that we examine under the microscope are normally very thin slices from the brains of people or animals that have passed away. The brain slices can be stained using special methods that allow the neuron-trees and the jungle-creatures to be seen in different colors, which makes searching for them much easier. For example, one kind of creature can be colored neon-green, so that it can be observed apart from the rest of the jungle, which would appear black. This would be like looking at the Amazon rainforest at night through your binoculars and seeing only the spider monkeys in neon-green, while the rest of the forest remains pitch-black. An amazing aspect of using a microscope is that you completely forget how small the things you are looking at truly are. Peering through the microscope at a small part of the brain slice is like looking down at the canopy of the rainforest from a helicopter. As you adjust the microscope to magnify the brain-jungle and bring it into focus, you find yourself curiously peeking in between the leaves of the Amazon rainforest. Instead of meeting eye-to-eye with a family of colorful tree frogs huddling together in the soft moss covering the tree branches, you will find yourself looking right at the brain-creatures referred to as **glial cells**.

WHAT DO THE GLIAL-CREATURES DO?

Using microscopy, scientists observed these glial-creatures wrapping tightly around the neuron-tree trunks and found other creatures in between the branches and roots of the neuron-trees (Figure 1). What are these creatures doing there? Well, it took a long time for scientists to appreciate how important these creatures truly are. Initially, many scientists believed that they were simply the soil holding all the

Figure 1

One of the billions of neuron-trees in the brain-jungle. The neuron-tree is surrounded by the three kinds of glial-creatures. An oligodendrocyte wraps its legs around the trunk of the neuron-tree to provide insulation. Two astrocytes are found among the roots and the leaves where they nurture the neuron-tree. A microglia is surveying around the neuron-tree. Its job is to remove dead or dying roots and branches and protect the brain-jungle from intruders. The glial creatures' names and colors match, so that you can tell them apart.



Figure 1

neuron-trees together. That is why all the creatures in the brain, except the neurons, were named glia, which means “glue” in Greek. Today, we know that these glial-creatures are a crucial part of the brain-jungle because of the unique ways that they interact with the neuron-trees [2–4].

There are several kinds of glial-creatures, and this article focuses on three types: **oligodendrocytes**, **astrocytes**, and **microglia**. Each type plays a vital role in the daily life of your brain-jungle. Unlike most animals in the real rainforest, these glial-creatures do not move their entire bodies around the brain-jungle. Instead, they use their many legs to carry out the functions that make them so important for the neuron-trees.

The oligodendrocytes wrap their legs around the trunks of the neuron-trees to form numerous layers of mossy blankets. The neuron-trees depend on this mossy insulation to protect their trunks and to smoothly send signals through their trunks [5]. To remember where to find the oligodendrocytes within the brain-jungle, you can think of them as the sloths of the rainforest, wrapping their legs around the tree trunks.

The astrocytes are found almost everywhere in the brain jungle. But it is near the roots and among the branches and leaves of the neuron-trees that they play their important role of nurturing the neuron-trees. Without astrocytes, the network of neuron-tree roots would crumble

OLIGODENDROCYTES

Specialized glial cells that wrap tightly around the neurons.

ASTROCYTES

A population of glial cells that support and nurture the neurons.

MICROGLIA

Dynamic glial cells that eat damaged neurons and protect the brain.

and the leaves would start wilting away [6]. To remember where to find the astrocytes, think of them as centipedes, with their hundreds of thin legs that intertwine with the root system or as pollinating hummingbirds among the leaves in the treetops.

Finally, the microglia are the smallest of these glial-creatures, but the fiercest and most dynamic. Their job is to remove dead or dying roots and branches and to protect the brain-jungle from intruders like viruses and bacteria [7]. Like astrocytes, microglia are found all over the brain-jungle, where they constantly move their arms and legs around to patrol the entire jungle [8]. To remember these small, hard-working microglia, think of them as leafcutter ants that are trimming the leaves of the neuron-trees. You could also think of them as the howler monkeys of the brain-jungle, who will alert everyone around if something is disrupting the jungle's daily routine.

MUCH MORE TO LEARN ABOUT GLIAL-CELLS

Thanks to the combined effort of these glial cells, your neurons can carry out their important functions. Observing glial cells through the microscope has been an extremely exciting expedition thus far, but we have much more to learn about the complexity of the glia and what they do. Just like a real rainforest, your brain-jungle is a marvelous place in which all your memories are stored within the networks of neurons, and with the glial cells as caring foresters. It is because of this fascinating interplay within your brain that you can read the words on this page and imagine an overgrown rainforest full of all kinds of different creatures: it is all in your head!

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YOUNG REVIEWERS



AOIFE, AGE: 9

My name is Aoife. I am interested in reading. My favorite types of books are about history, especially books about Ancient Egypt and the Medieval Ages. When I grow up, I want to be a history teacher. I also like funny books where kids write about their lives, like Tom Gates, Marty Pants, and Timmy Failure. For exercise, I really like going outside and ride my bike with my family. My best friends are Chase and Greta.



LAURA, AGE: 9

Hi, my name is Laura. I live with my two older brothers and my parents. In my free time I enjoy reading, biking, and spending time outdoors. There is a forest in my backyard where I enjoy going on the trails that me and my brothers made. The book I currently read is “Treasure Hunters” by James Patterson. I love animals and in particular little puppies. When I grow up, I want to be a scientist or a vet.

AUTHOR

LASSE DISSING-OLESEN

Growing up in Denmark, Lasse’s childhood dream was to explore the rainforest in search of wild animals. After high school, he lived out that dream and traveled to many exciting places around the world, including Asia, Africa, and Latin America. However, it was not until he went to the University of Southern Denmark and looked at the brain under a microscope that he found the creatures



he was looking for! After obtaining a Ph.D. in neuroscience at the University of British Columbia, Canada, he joined Boston Children's Hospital, Harvard Medical School, in Boston, USA to continue studying these fascinating brain-creatures.
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