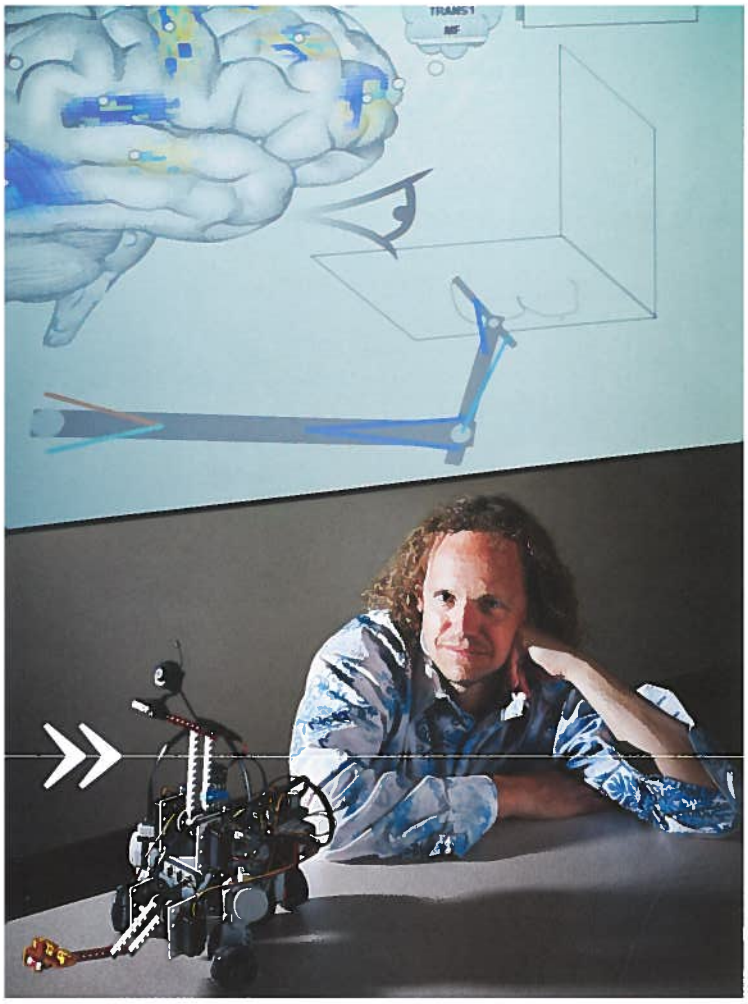

Chris Eliasmith (BASc '94, SD), a Waterloo systems design engineering and philosophy professor, says understanding how the brain works is inherently interdisciplinary.

REVERSE ENGINEERING THE BRAIN

Want to build a working brain? Then speak to Chris Eliasmith. The Canada Research Chair and Director of the Centre for Theoretical Neuroscience at Waterloo has developed the world's largest model of a functional brain — and revealed exactly how he it did it in a recently-released book fittingly called *How to Build a Brain*, published by Oxford University Press.

Step one was to assemble a team of students from engineering, biology, computer science and philosophy. "Understanding how the brain works and the mind works is inherently interdisciplinary," says Eliasmith, whose own education includes degrees in systems design engineering (BASc '94) and philosophy (MA '95) from Waterloo.

On the medical side, Spaun may revolutionize the way brain disorders are treated.

He and his students initially modelled different functions of the brain: vision, motor control, memory, and so on. But Eliasmith, who is both a Waterloo professor of systems design engineering and philosophy, understood that what really mattered was how these pieces worked together so he set out to create a model that could coordinate those different functions.

The result is Spaun: a computer-based simulation that can perform several activities and switch between them, just like a real brain. It consists of an eye for receiving visual input, a brain capable of performing several cognitive functions and an arm to execute a variety of tasks.

Spaun can read, answer questions, play simple games, memorize lists and draw what it sees. Like the real thing, it even makes mistakes, faltering at complex questions or tripping up when lists get too long.

A WORLD OF POSSIBILITIES

The secret to the virtual grey matter lies in its 2.5 million simulated neurons, connected together in a way that mimics the biology and behaviour of the brain. Although it's a far cry from the 100 billion neurons of a real human brain, Eliasmith's team is already working on building hardware specifically designed to run larger-scale simulations. "The only reason we stopped at 2.5 million neurons is because computers are too slow," he says.

According to Eliasmith, those simulations bring us closer to understanding the relationship between complex brain activity and complex behaviour, opening up a world of possibilities.

For starters, it could herald in a new generation of sophisticated, more human-like computers with which interactions are much easier. On the medical side, Spaun may revolutionize the way brain disorders are treated. Using the model, researchers could simulate the impact of different drugs or mimic the damage caused by strokes or Alzheimer's to better understand what's going on and identify ways to restore brain function.

Reverse engineering the brain is no easy feat. But thanks to the work of Eliasmith and his team at Waterloo, we're now closer to unlocking one of life's greatest mysteries: how humans think.