Rockefeller University’s Roderick MacKinnon, the 2003 Nobel Prize winner in chemistry, then discussed his own basic research, which has revealed the structure and function of the neurons’ ion channels, or as MacKinnon called them, “the brain’s electrical impulse generators.”

The impulses must be sent through brain’s highly organized circuits to control movement, cognition, and consciousness. Although many circuits are not understood, Jessell said, he outlined his progress on circuits that control movement, showing how the basic circuits are hard-wired by one’s genes, but experiences, for instance, of learning to walk or play the violin refine the circuits.

2000 Nobel Prize winner Eric Kandel, University Professor of Physiology and Psychiatry, showed the audience just exactly how those circuits are refined during learning. Changes in synapses—which connect all neurons—occur during learning, he said, and was even happening while he spoke. “You will walk out of the symposium with a different brain than you walked in with,” he said.

Speakers in the second session, “Brain Function and Disease,” showed how new techniques in brain imaging are changing the way scientists think about brain disorders, which afflict one in seven people.

For example, schizophrenia was initially thought to stem from brain changes acquired in adulthood, said Judith Rapoport of the National Institutes of Health. “But with brain imaging we’re finding that children have problems even before the onset of schizophrenia.”

Her studies show that while the brains of all children lose brain mass through childhood, children who eventually develop schizophrenia lose more.

Nora Volkow, director of the National Institute on Drug Abuse, uses a different kind of brain imaging to understand why addicts are unable to control drug intake. Her PET scans of addicts and non-addicts suggest that high levels of dopamine receptors in one part of the brain can protect people from becoming addicted. “What’s surprising is this happens in the frontal cortex, which is not normally believed to be involved in addiction,” she said. “The frontal cortex weighs the value of one thing to another, so in designing treatments we need something that will alter motivation.”

In the final session, “Biology of Mind,” speakers continued to explore the power of brain-imaging techniques by addressing questions of how the brain constructs the mind. Still, they noted that recording from individual neurons still remains the gold standard of neuroscience.

In the study of decision-making, neuroscientists have traditionally emphasized the effects of sensory stimuli on the outcome of the decision process. “But this is an impoverished view,” said William Newsome of Stanford. “An organism’s prior experience or beliefs concerning the ‘value’ of the alternative choices can influence decisions even more than sensory input.”

Newsome described how recordings from monkeys making decisions are helping researchers discover which neural circuits are used to calculate value and how values influence decision-making.

Christof Koch of Caltech also employs neuronal recordings in conjunction with brain imaging to chase down the neural underpinnings of consciousness. “Many people think consciousness can’t be addressed by scientific methods,” Koch said, “but we should be cautious of that assertion since we’ve made that mistake several times in history.”

Philosopher John Searle, from the University of California at Berkeley, also thought that consciousness was an accessible problem. Searle drew an analogy with his glass of water: Just as liquidity is a higher order feature of the behavior of individual H2O molecules, the mind is a higher order feature of the activity of neurons.

“The brain causes minds,” he said.

For more information, go to: www.c250.columbia.edu/c250_no w/symposia/brain_and_mind.html.