Obesity is the leading preventable cause of death worldwide, with increasing rates in adults and children. Health authorities view it as one of the most serious public health problems of the 21st century. In the United States, more than one-third of the population is clinically obese. One reason is that food is easy to get, calorically dense and tasty.

Gina Leinninger calls it the “dessert phenomenon.”

“You may be full and your body has all the energy that it needs, but that chocolate cake looks so delicious. So, we are taking in more calories than we need,” said Leinninger, an assistant professor in the Department of Physiology and MSU’s Neuroscience Program. Through her research, she wants to find ways to decrease the desire to eat and increase the desire to move around, especially in people who are clinically obese.

Although there are aesthetic issues with obesity, the major problem is that obesity predisposes individuals to type 2 diabetes as well as heart disease, stroke and certain types of cancer.

“Diet and exercise do not work long-term for people who are obese, and there are no effective treatments,” said Leinninger, whose research focuses on how neurons in the lateral hypothalamic area (LHA) of the brain may contribute to obesity and a lack of a desire to move around.

“The LHA is a crucial area of the brain for regulating feeding, drinking, sleep and locomotor behaviors that directly affect weight,” she continued. “We believe there are neurons in a particular part of the brain that are activated by stimuli that cause you to eat less but move more. If we activate those neurons, we can suppress the desire to eat but increase actions to move around. If we could perpetuate that, it would promote weight loss.”

Leinninger and her team have developed tools using Cre-lox techniques that allow manipulation of only certain populations of neurons at one time.

“That allows us to specifically say what these neurons do compared to other neurons,” she explained. “Cre-lox techniques have been used for 10 to 15 years, but we developed specific Cre-lox tools and applied them to our research.”

In the past, the theory was that all neurons in the LHA promoted feeding. Now the idea is that there might be different kinds of neurons in that part of the brain, which might be manipulated for specific effects. Leinninger’s research was the first time that someone described neurons in this part of the brain that did something different.

“It has changed our theories on how the brain works,” she said. “It also has made it more complicated because, in some cases, we have neurons that do two things. It’s a cool, dynamic part of the brain.”

Leinninger’s long-term goal is to understand how the neuronal circuit should work, then design strategies to increase the activation of specific neurons in that circuit that will decrease the desire to eat and increase the desire to move around.

“A lot of people think obesity is just a will power issue, but it isn’t,” explained Leinninger, who is also a member of MSU’s Molecular Metabolism and Disease research program. “The brain circuits have changed, and they actively prohibit weight loss. That is why we need something to make it easier for people to make lifestyle changes to promote weight loss. However, even with significant advances in research in this area, it will take time to figure out how to rewire the brain.”