There are a variety of research approaches in neuroscience that advance our understanding of how the nervous system works. In "basic" neuroscience, scientists ask and answer questions about the function of cells and systems, often laying the foundation for approaches scientists can leverage in animal models and human studies. In "translational" neuroscience, scientists ask and answer questions that are specific to health or diseases, often attempting to develop treatments or interventions for human conditions by leveraging animal models. Here are some examples.

Advances in Basic Neuroscience

The Brain's Chemical Code The development and use of neuroanatomical techniques in rodents and monkeys advanced knowledge of how neurons communicate with each other. This led to a molecular understanding of the synapse, the communication point between neurons that is affected in several brain disorders.

Neural Circuitry of Memory Studies in rodents and monkeys revealed the neural circuitry and molecular mechanisms of memory that have implications for Alzheimer's disease, aging, and disorders related to emotional learning, like post-traumatic stress disorder (PTSD).

Healthy Aging The brains of old animals provide deep insights into age-related changes in molecules, cells, and circuits. Aged rodents and monkeys help scientists design interventions to delay aging and to understand the difference between healthy aging and pathological changes requiring treatment.

Advances in Translational Neuroscience

Stroke The study of rodents guided the successful development of treatments such as brain cooling along with drugs that dissolve clots blocking blood flow to the brain which reduce damage after a stroke.

Neurodevelopmental Disorders Numerous inherited brain disorders, including autism spectrum disorder, are associated with mental disabilities. The use of rodent and domestic animal models in research contributed to the understanding of these diseases and provided translational models to develop novel pharmacotherapeutics, as well as gene and stem cell therapies.

Depression, Bipolar, and Anxiety Disorders Research in rodents and monkeys revealed the brain pathways and biochemical systems that control mood, anxiety, fear, and stress responses. These discoveries led to improved treatments that more directly target the key neurotransmitters altered in psychiatric illnesses such as depression, bipolar, and anxiety disorders such as PTSD.

Drug Addiction Rodent and monkey research led to the understanding of addiction as a brain disease caused by alterations of chemical signaling. Knowing the mechanism of addiction allows scientists to test new treatments.

Brain-Machine Interface (BMI) Research with monkeys drove the development of small brain implants that monitor brain activity and allow the brain to communicate with mechanical devices. Humans are now able to control artificial limbs and computer programs with their own brains.

Therapy Developments

Retinal Degeneration Canine models have been studied to understand the molecular basis of blindness. This led to the development of gene therapy now effectively used in humans.

Deep Brain Stimulation Studies of animals led to understanding the circuitry affected in Parkinson's disease and the mechanisms that cause neurodegeneration. Monkeys were essential in developing deep brain stimulation, a surgical alternative to the limited drug treatments available to patients with Parkinson's disease and some patients with drug treatment-resistant depression.

Vaccines Research using monkeys led to the understanding that viruses caused polio and measles, set the stage for subsequent vaccine development for viral threats such as the Zika virus and COVID-19.

For more information, visit

brainfacts.org/In-the-Lab/Animals-in-Research

Accomplishments of Animal Models in Biomedical Research

Advancing Neuroscience, Improving Health Outcomes

SfN Society for Neuroscience