



ABOUT THE ALLEN MOUSE BRAIN ATLAS

The [Allen™ Mouse Brain Atlas](#) is a free, publicly available Web-based 3D map of the adult mouse brain. The Atlas details the activity patterns of approximately 20,000 genes at the cellular level. Similar in scope to the Human Genome Project, the Atlas provides researchers with a comprehensive online vehicle for exploring where each gene is expressed, or “turned on,” in the brain. The Allen Mouse Brain Atlas data and its sophisticated search and viewing tools are used each day by thousands of researchers worldwide. The Atlas, launched with \$41 million in seed money from philanthropist and Microsoft co-founder Paul G. Allen, was initiated in 2003 and completed in 2006.

“By taking advantage of the data, we can really start identifying the specific circuitry that went astray in a specific disease condition. Neuroscience has been around many decades. But **combining the classical approaches of brain research with this new genetic approach is a breakthrough in neuroscience.** It’s a new, extremely powerful approach to try to understand the brain. I would say it’s revolutionary.”

- Susumu Tonegawa, Nobel Laureate, Director, Picower Center for Learning and Memory at the Massachusetts Institute of Technology

IMPLICATIONS

Prior to completion of the Allen Mouse Brain Atlas, a free, comprehensive resource integrating genomic and anatomic data of this scale did not exist. During that time, it would have taken one researcher several months to analyze one gene. Now they can go online to view the entire genome. The mouse is a well-established model for the study of human diseases and therapies. The vast majority of human genes have a mouse counterpart, and mouse and human brains share the same basic structural and functional architecture. Therefore, the Allen Mouse Brain Atlas has great potential for advancing understanding of brain diseases and disorders. Such disorders, which affect millions of people and cost billions of dollars each year, include:

- **Mental disorders** - affect one in four, or 57.7 million Americans ([National Institute of Mental Health - NIMH](#))
- **Autism** - affects 1 to 1.5 million Americans, costing \$90 billion annually ([Center for Disease Control and Prevention - CDC](#))
- **Epilepsy** - affects an estimated 2.5 million Americans costing \$15.5 billion annually ([Center for Disease Control and Prevention - CDC](#))
- **Alzheimer’s disease** - affects up to 4.5 million Americans, including an estimated 50 percent of people 85 and older; Every 70 seconds, someone develops Alzheimer’s ([National Institute on Aging - NIA](#))
- **Schizophrenia** - affects about 2.4 million, or one in 100 American adults ([National Institute of Mental Health - NIMH](#))
- **Parkinson’s disease** - affects 500,000 Americans, with 50,000 new cases diagnosed each year ([National Institute of Neurological Disorder and Stroke - NINDS](#))

SCIENTIFIC MODEL

The Allen Institute employs a high-throughput model, collecting data using an assembly line approach. The combination of laboratory robots, automated imaging devices and high-powered computational systems enables the generation of data on an unprecedented scale. The Allen Mouse Brain Atlas was produced using a process called *in situ* hybridization, which pinpoints and stains specific areas where a gene is expressed, or “turned on.” By analyzing series of thin tissue sections, this allows scientists to view gene activity throughout the entire brain, down to the level of individual cells. Digital photographs were obtained using automated microscopes and incorporated into free, Web-based viewing applications.

KEY ATLAS FEATURES

- Free, public online access with no registration requirement.
- Image-based data comprising genome-wide coverage.
- Comprehensive anatomic coverage of the adult mouse brain.
- Microscopic resolution down to the cellular level.
- Sophisticated data search and viewing tools.
- Interactive 3D Brain Explorer® viewing application.
- Detailed anatomic reference atlas of the adult mouse brain that can be viewed with the data.

KEY FINDINGS

While the Allen Institute produces high-impact projects, it also analyzes and conducts research. As part of this project, the Allen Institute identified several significant findings:

- At least 80 percent of genes are “turned on” in the brain, and only a few of these are expressed in a single area. Both of these findings have implications for interpreting and predicting side-effects of therapeutic drugs.
- Gene expression patterns reveal novel subdivisions of known brain structures and new molecular markers of specific cell types, advancing a more detailed and refined understanding of the structural and functional architecture of the brain. Similar to understanding the parts of an engine, such detailed knowledge of gene expression is essential to understanding how the brain works, diagnosing problems when things go wrong, and defining effective therapeutic strategies to address these problems.

TECHNOLOGY AND SCALE

- 1 terabyte (1,000 gigabytes) of data was produced daily
- 170 genes were processed per day
- 1 gigabyte of data was generated per gene
- A total of 250,000 microscope slides were processed and 85 million images were captured to create the Atlas
- Over 600 terabytes of data was generated

HOW IT'S BEING USED BY THE COMMUNITY

The Atlas is widely used, across the globe and across diverse areas of brain research. It averages approximately 15,000 unique users per month. The primary scientific publication on the Atlas, a peer-reviewed paper in *Nature*, has been cited in the scientific literature more than 300 times since it was published in January 2007. Currently, the Atlas is being used by scientists in a variety of settings, including:

Universities – A team of Stanford researchers used the Atlas to further understanding of glia - critical support cells within the brain. Data from the Atlas is cited in their November 2006 *Journal of Neuroscience* paper, which identifies new candidate genes possibly related to multiple sclerosis susceptibility.

Research Institutes – As part of an international collaborative study published in *Science*, investigators at the Translational Genomics Research Institute (TGen) in Arizona, used the Atlas to confirm findings about a gene linked to human memory performance.

Clinical Practices – Surgeons at the Swedish Neuroscience Institute in Seattle, WA use the Atlas to help match individual brain tumor patients to the most promising therapies.

Corporations – Large pharmaceutical companies use the Atlas to discover and develop drugs that are safer and more effective.

Government Organizations – Researchers from the National Institutes of Health access the Atlas to address a wide variety of questions about the brain in health and disease.

PRIMARY PUBLICATION

Lein, E.S., Hawrylycz, M.J. et. al. (2007) Genome-wide atlas of gene expression in the adult mouse brain, *Nature* 445:168-176, doi:10.1038/nature05453

WEB SITES

To learn more about the Allen Institute, visit www.alleninstitute.org. To access the Allen Mouse Brain Atlas and other public resources from the Allen Institute, visit www.brain-map.org.

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