

6.2 Man and mouse

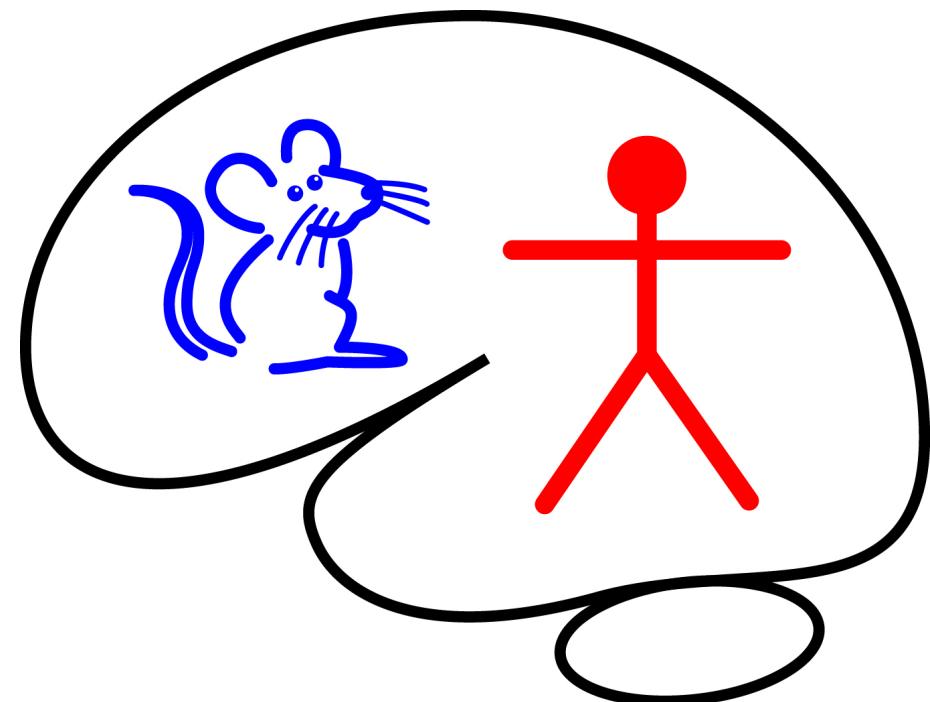
Cellular Mechanisms of Brain Function

Prof. Carl Petersen

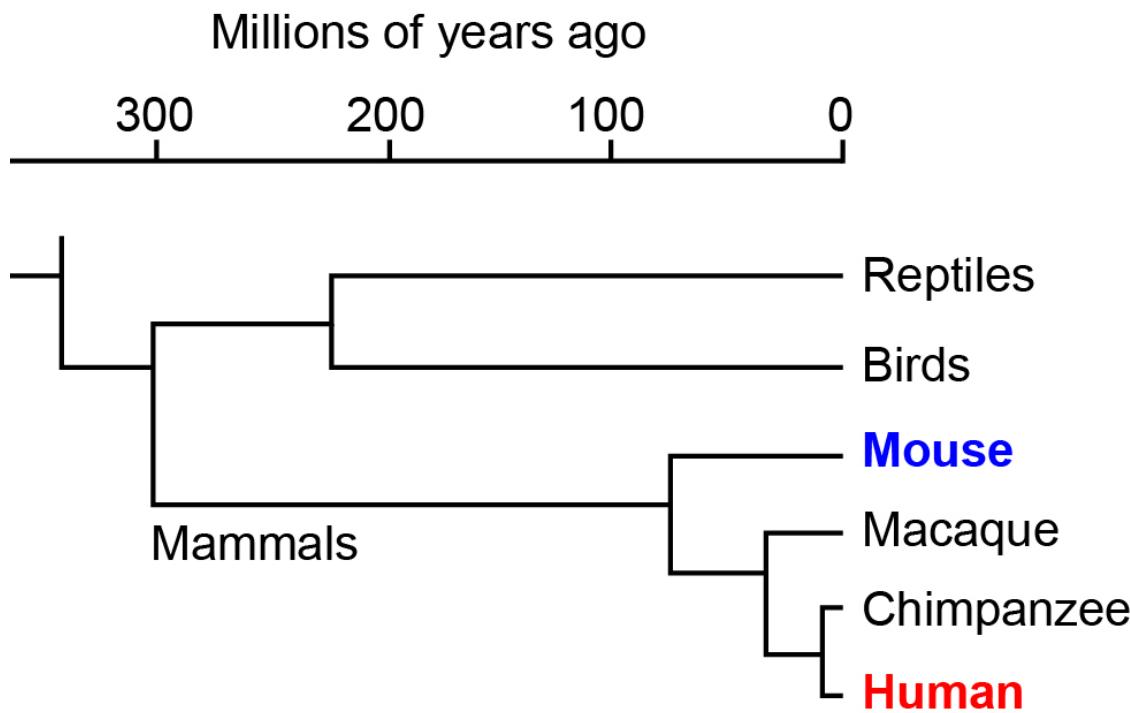
The mammalian brain



Man and mouse



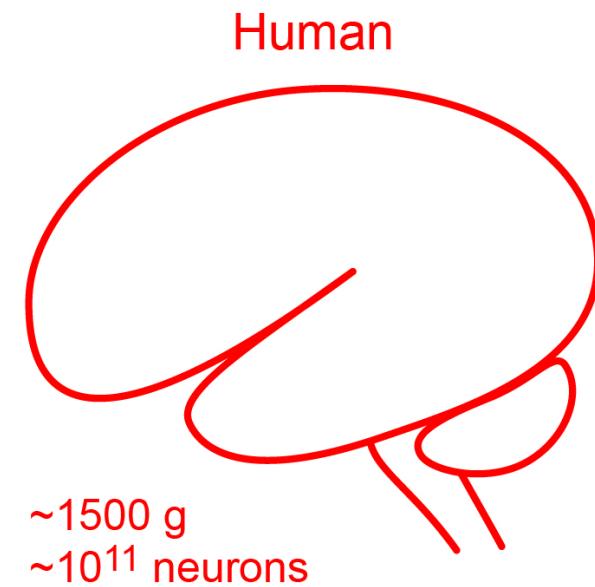
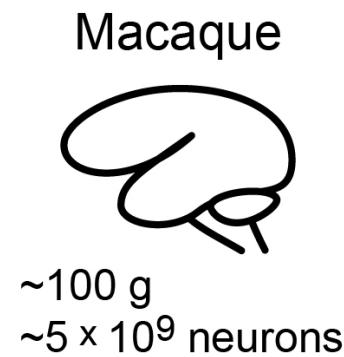
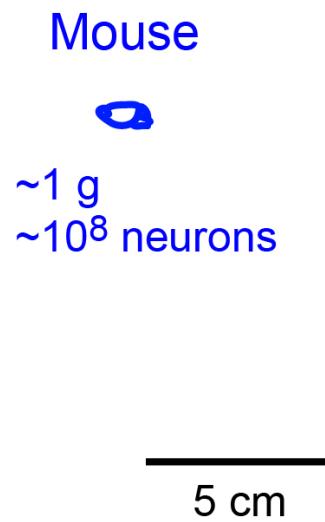
Evolution



The closest common ancestor between man and mouse is thought to have lived ~80 million years ago.

~99 % of genes coding for proteins have homologs comparing man and mouse.

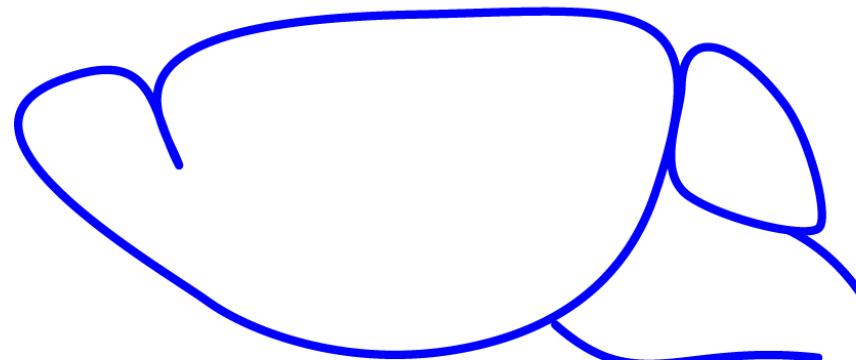
Mammalian brain size



There are big differences in brain size and neuron numbers.
However, many of the organising principles are very similar.

Organisation of the mammalian brain

Mouse



Human



Mouse genetics



www.ncbi.nlm.nih.gov

The screenshot shows the NCBI Gene search interface. The search term "mus musculus gria2" has been entered. The results page displays three entries:

Name/Gene ID	Description	Location	Aliases
Gria2 ID: 14800	glutamate receptor, ionotropic, AMPA2 (alpha 2) [Mus musculus (house mouse)]	Chromosome 3, NC_000069.6 (80682904..80803204, complement)	GluA2, GluR-B, Glur-2, Glur2
Grid2 ID: 14804	glutamate receptor, ionotropic, delta 2 [Mus musculus (house mouse)]	Chromosome 6, NC_000072.6 (63256832..64701910)	B230104L07Rik, GluD2, GluRdelta2, Lc, Lc-J>, MMS10-AC, Ms10ac, cpr, ho, nmf408, tpr
Gria1 ID: 14799	glutamate receptor, ionotropic, AMPA1 (alpha 1) [Mus musculus (house mouse)]	Chromosome 11, NC_000077.6 (57011571..57330244)	RP23-102H8.1, 2900051M01Rik, Glr-1, Glr1, GluA1, GluR-A, GluRA, Glur-1, Glur1, HIPA1, gluR-K1

Display Settings: Tabular, 20 per page, Sorted by Relevance Send to:

Results: 10

Filters activated: Current only. [Clear all](#) to show 10 items.

www.jax.org

The screenshot shows the The Jackson Laboratory website. The main navigation bar includes links for Genetics and your health, Courses and education, Research and resources, and JAX® Mice and Services. A large image of a brown mouse is prominently displayed.

In this section

- Find & order JAX® Mice
 - Order JAX® Mice
 - Search JAX® Mice database
 - Most popular JAX® Mice strains
 - JAX® Mice & Services by research area
 - New JAX® Mice strains
 - International orders
- Breeding & rederivation services
- Cryopreservation & recovery services
- In vivo pharmacology services
- Genome science services
- Surgical & preconditioning services
- Cells, tissues & products
- News, events & webinars
- Customer service & support
- Animal health & genetic quality

Home > JAX® Mice and Services > Find & order JAX® Mice

Find and order JAX® Mice

JAX® Mice are the most published and well characterized mouse models in the world, and include the only fully sequenced strain, C57BL/6J. They are supported by our extensive online resources, knowledgeable technical support team and world-renowned research staff. Our most popular mouse models are readily available in the quantities you need to support your biomedical research.

- Search the JAX® Mice database
- Order form for JAX® Mice
- International orders

NCBI - National Center for Biotechnology Information

Cellular Mechanisms of Brain Function

Gene-expression maps of the mouse brain



mouse.brain-map.org/gene/show/13267

ALLEN INSTITUTE BRAIN ATLAS

ALLEN BRAIN ATLAS DATA PORTAL

Drd1a - RP_050825_01_E12 - sagittal

Experiment

Gene	Drd1a
Probe Type	RNA
Probe Orientation	Antisense
Plane of Section	sagittal
Treatments	ISH

Specimen 05-2389

Organism	Mus musculus
Strain	C57BL/6J
Age	56
Sex	M

Related Institute Data

MOUSE HUMAN

Brain Explorer View in 3D

1678 microns

Three small images at the bottom show other brain sections.

www.brain-map.org

Allen Brain Atlas

Complete gene expression atlas of the mouse brain.

Cellular Mechanisms of Brain Function

Genetically-defined cell-types



Transgenic or knock-in of GFP, Cre-recombinase, ...

Cre-LoxP system for precise genetic manipulation

LoxP = **ATAACTTCGTATAGCATACATTATACGAAGTTAT**

Highly-specific genetic manipulation in well-defined cell-types.

Essential for causal and mechanistic understanding of brain function.

Cre-LoxP system is part of a family of recombinases e.g. Flp-FRT

Projection maps of the mouse brain



www.brain-map.org

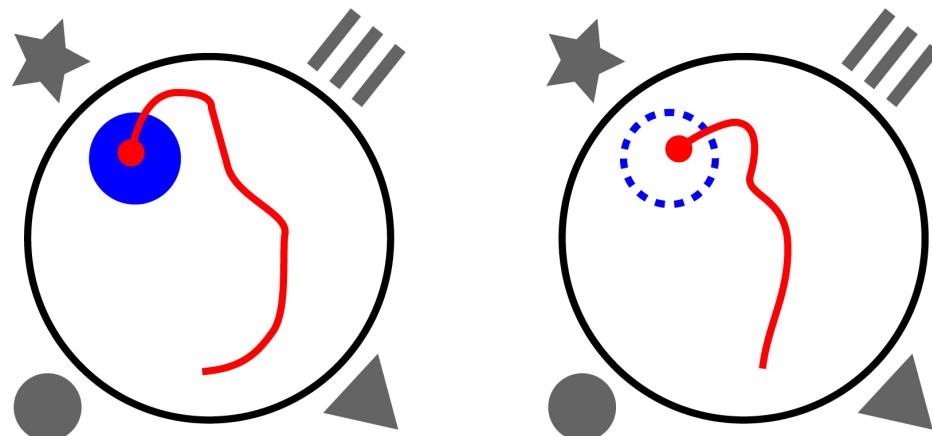
Allen Brain Atlas

Long-range connectivity
map of the mouse brain.

Cellular Mechanisms of Brain Function

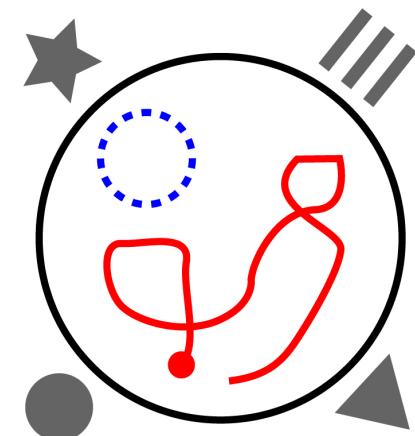
Mouse behavior

Morris water maze

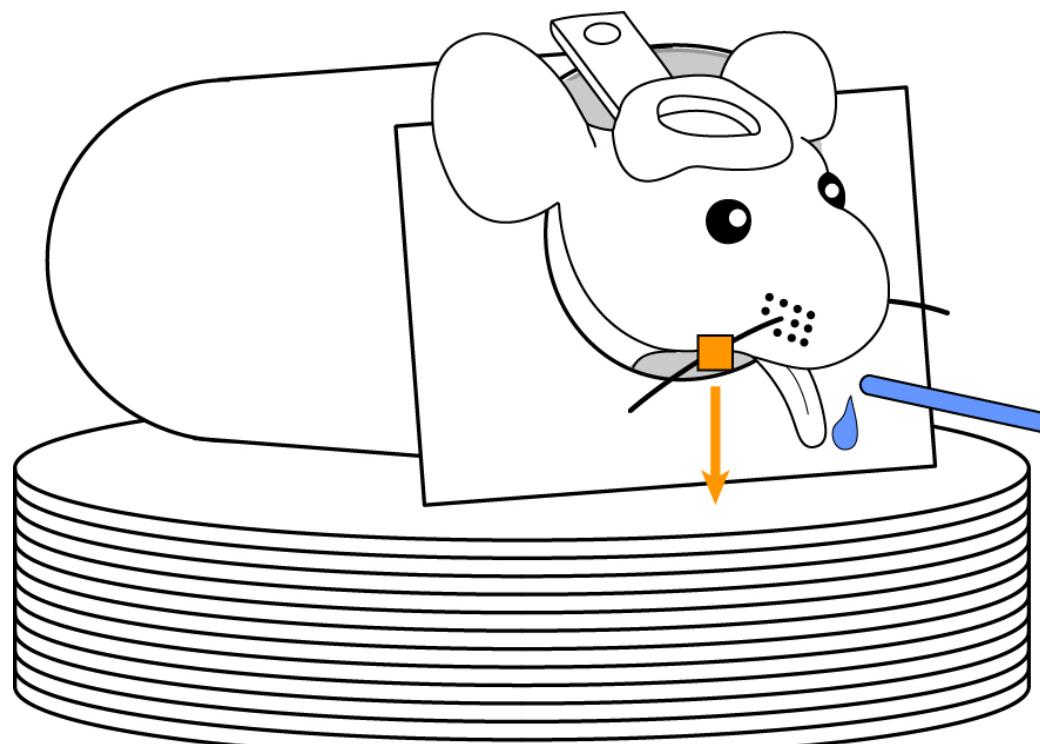


CA1 knockout of NMDA receptors

CA1-Cre
x
Flox-NR1



Head-restrained mouse behavior



Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

Cellular Mechanisms of Brain Function

Brain dysfunction



Brain diseases make a big impact upon the world,
both at the level of individuals and for society as a whole.

A key goal for neuroscience is therefore to develop better treatments for brain diseases. In order to improve our ability to repair the brain it would be helpful to understand more about it.

Challenge: can we develop *rational* therapies for brain diseases?
Translational neuroscience research: mouse → monkey → man

Cellular mechanisms of mouse brain function



- Understanding the mouse brain will likely provide clues about the workings of the human brain.
- Large-scale efforts in mouse genetics and brain mapping are helping to accelerate research.
- The mouse is well-suited for detailed causal and mechanistic study of brain function during simple behaviors.