**Optogenetic, transient-sensing and chemogenetic mouse models available from The Jackson Laboratory.**

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## INTRODUCTION

Advancing the understanding of neural circuitry in both normal and diseased states is a priority of the biomedical community. To facilitate this challenge, The Jackson Laboratory (JAX) Mouse Repository offers an impressive array of genetically engineered tools enabling scientists to monitor neuronal activity in the intact mouse brain. Today, most in trans tool box are mouse lines with optogenetic and transient-sensing (calcium- voltage-, glutamate-) technologies. 

### A. INTRODUCTION

**OPTOGENETICS**

control of cellular functions in genetically modified cells using opsins - transmembrane, light-activated proteins that combine a light-sensitive domain with an ion channel or pump. Upon activation of light, the protein is activated and provides an input from membrane potential alteration and sensory functions to the brain. 

**TRANSIENT-SENSORS**

Calcium Indicators: GCaMP

- Ca2+ binding (neuron activation) → EGFP fluorescence (~50 nm)
- Optimized dynamics, improved baseline fluorescence, sensitivity & function
- GCaMP6s: ultrawide with slower decay & response kinetics
- GCaMP5: fast response kinetics

By sequentially expressing light-activated proteins that alter membrane potential in neurons, addition or removal of specific wavelengths of light can be used to regulate the activity of neurons for rapid control of neuronal activity.

### B. OPSINS

- ChR2
- Arch
- iCraF
- NPHR
- iGluSnFR

### C. DESIGN FOR GENETICALLY-ENCODED OPTOGENETIC MODELS

Creating a targeted mutation or transgene in mouse. Often, a fluorescent protein is engineered to be co-expressed.

**D. APPLICATIONS**

Flare opto-electrode delivers specific wavelengths of light to opens the ion channel - light controls neuronal signaling

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**Optogenetics, Cre-Inducible Lines**

A fixed-STOP cassette prevents transcription of opsins/xFPs, calcium sensors, photoactivatable GFP, etc.

**Cre-Tet-Inducible Lines**

Following Cre recombination, mice have dox-inducible / reversible expression of opsins, xFPs and calcium and glutamate sensors

**Specific Promoters**

- drive expression of opsins/xFPs, Ca2+ sensors and photoactivatable GFP

**Cre-FLP Dual Inducible Lines**

Multiple STOP cassettes prevent transcription of opsins/xFPs or fluorescent protein.

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**Search The Jackson Laboratory Repository / JAX Mice Database**

www.jax.org/mouse-search

Donating a Strain to The Jackson Laboratory

www.jax.org/donate-a-mouse

The Jackson Laboratory Resources for Optogenetics, Cre-Inducible Optogenetic Tools and Cre Strains available

www.jax.org/optogenetics

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**CHEMONEGENICS**

**DREADD**

- Designer Receptors Exclusively Activated by Designer Drugs; are mutant G-protein coupled receptors activated by small molecules.
- MGI: DREADD (Definitive, Functional, and Surface-Targeted Aktin)
- Gly Chloride Channels

**Gly XFPs**

Inhibitor-resistant Gly-Chloride channels

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**Thy1-GCaMP6 Lines**

**MMRRC**

Mutant Mouse Resource and Research Center at JAX

Human AP/FP mice with Approved’s disease mutations

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**Featured Images**

Correlating images of Thy1-GCaMP6 with MRI images (GPb, VPb, VPb3) and optical imaging (left-to-right) using customized plots and 3D models.