NEUROLEX: A SEMANTIC WIKI FOR NEUROSCIENCE

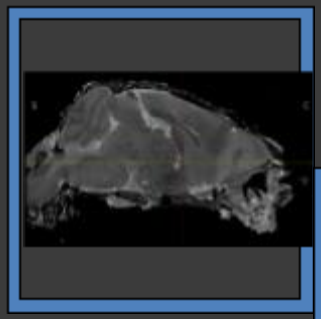
Stephen D. Larson

Implementing 'Big Open Data' in government through Open Collaboration - case examples and possibilities

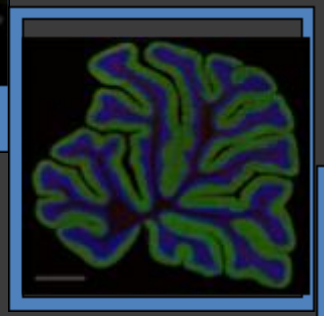
Joint Data.Gov – Ontolog "Big Open Data" Session

05/17/12

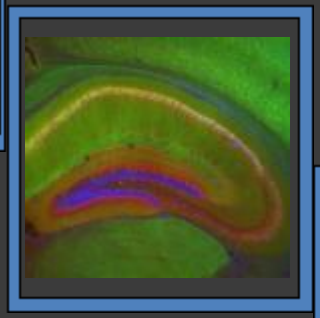
A multi-scale data problem



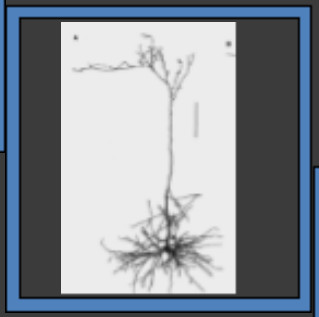
Whole brain data (20 um microscopic MRI)



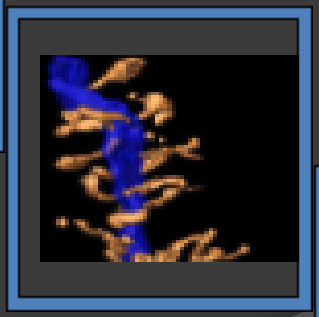
Mosiac LM images (1 GB+)



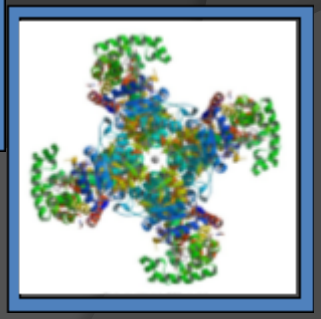
Conventional LM images



Individual cell morphologies



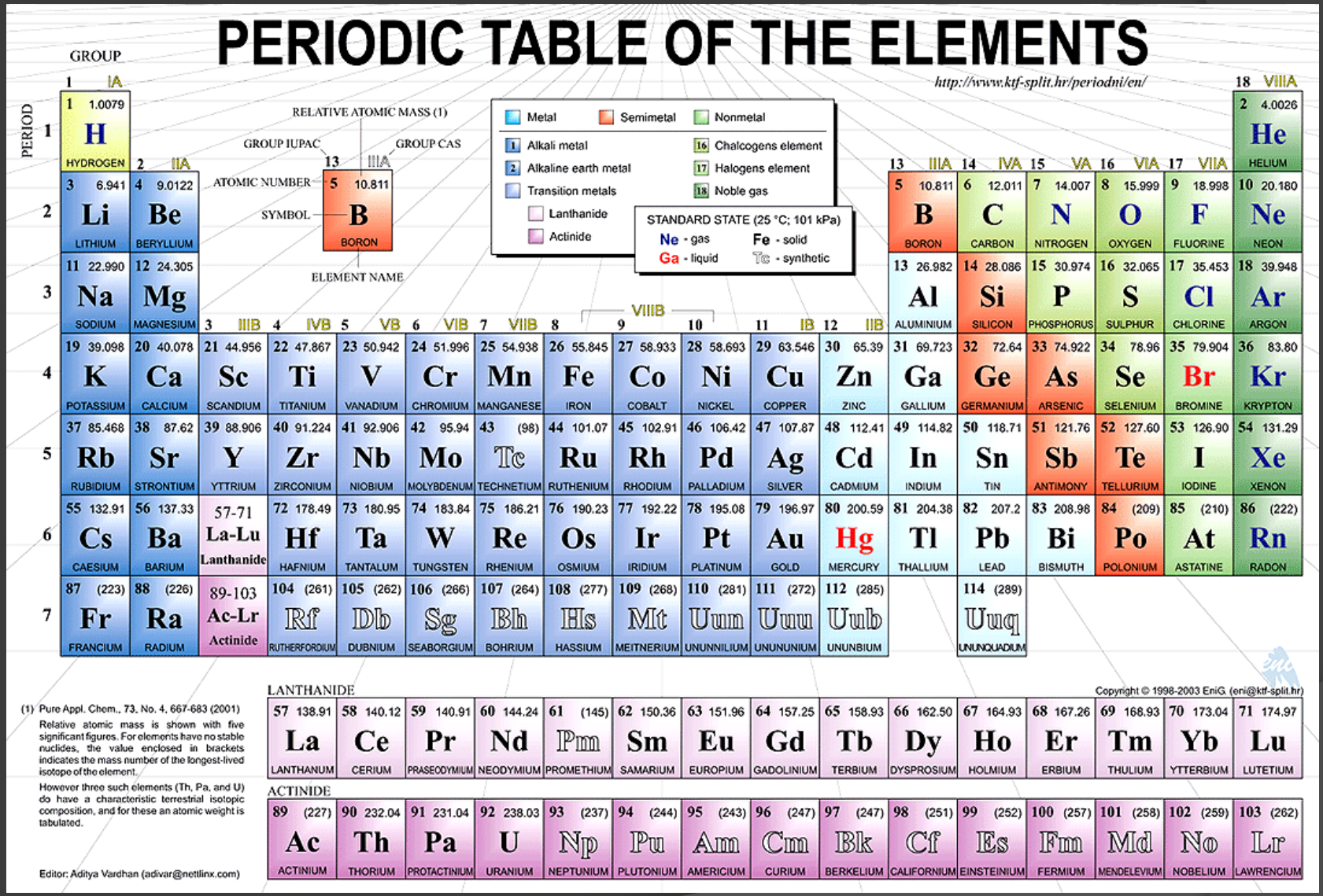
EM volumes & reconstructions



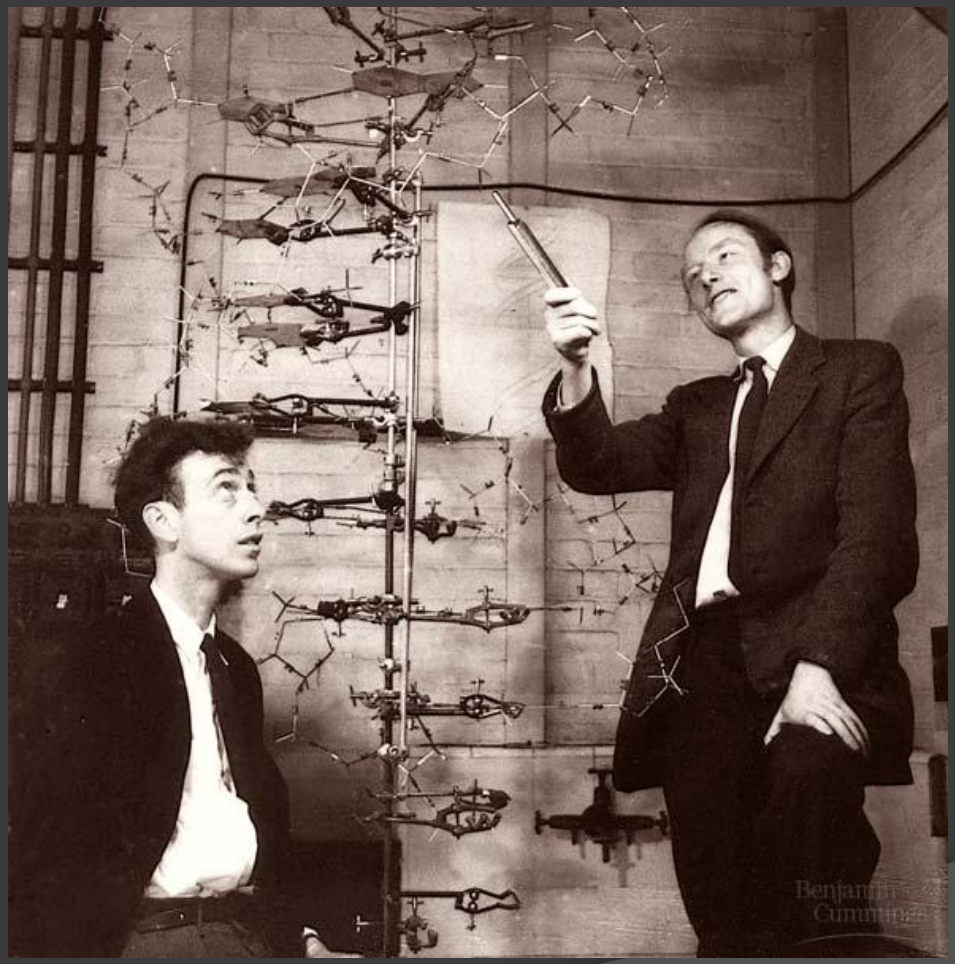
Solved molecular structures

Scale

Framework of parts



Multi-scale synthesis in biology



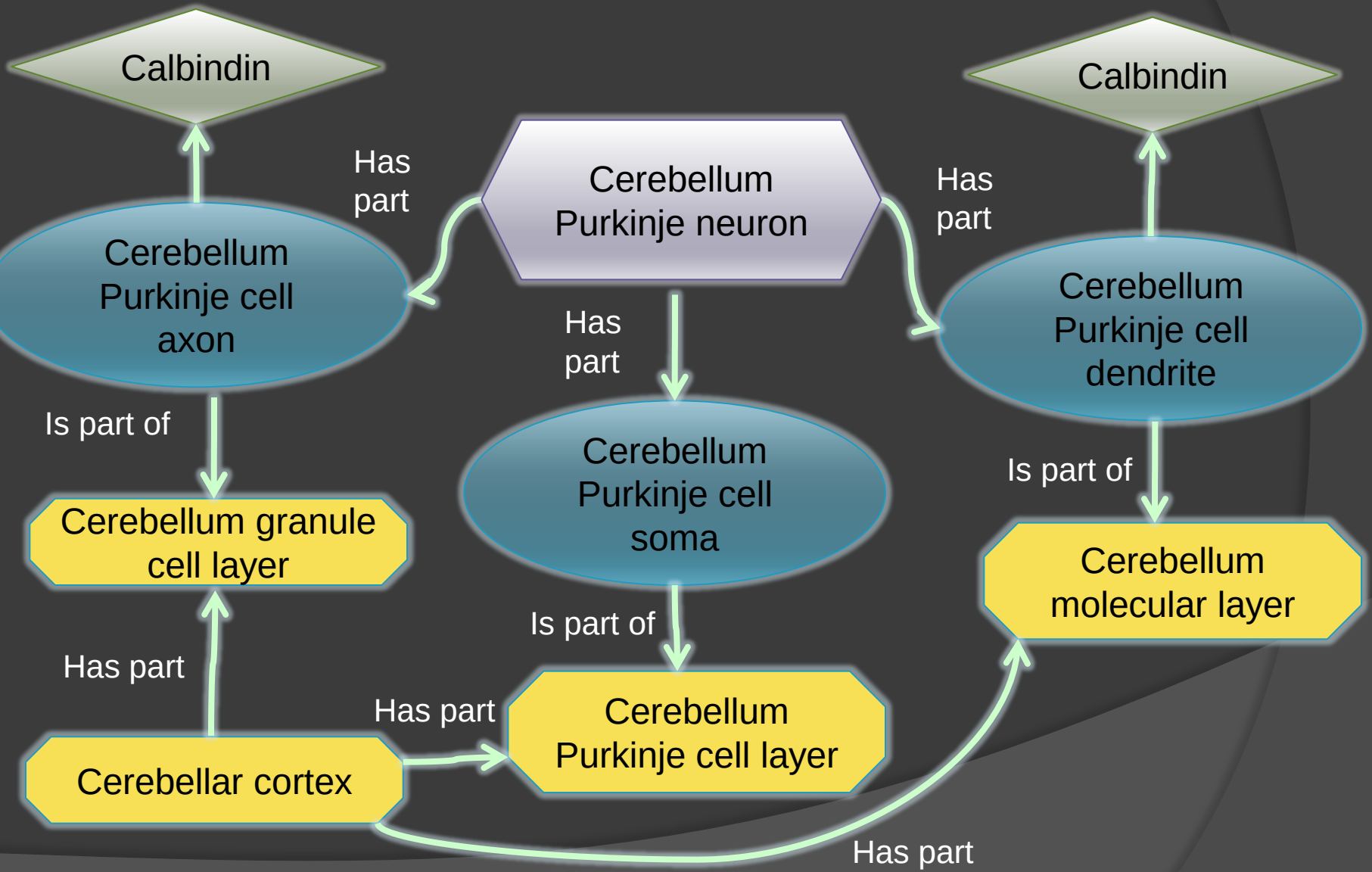
Watson & Crick, 1953

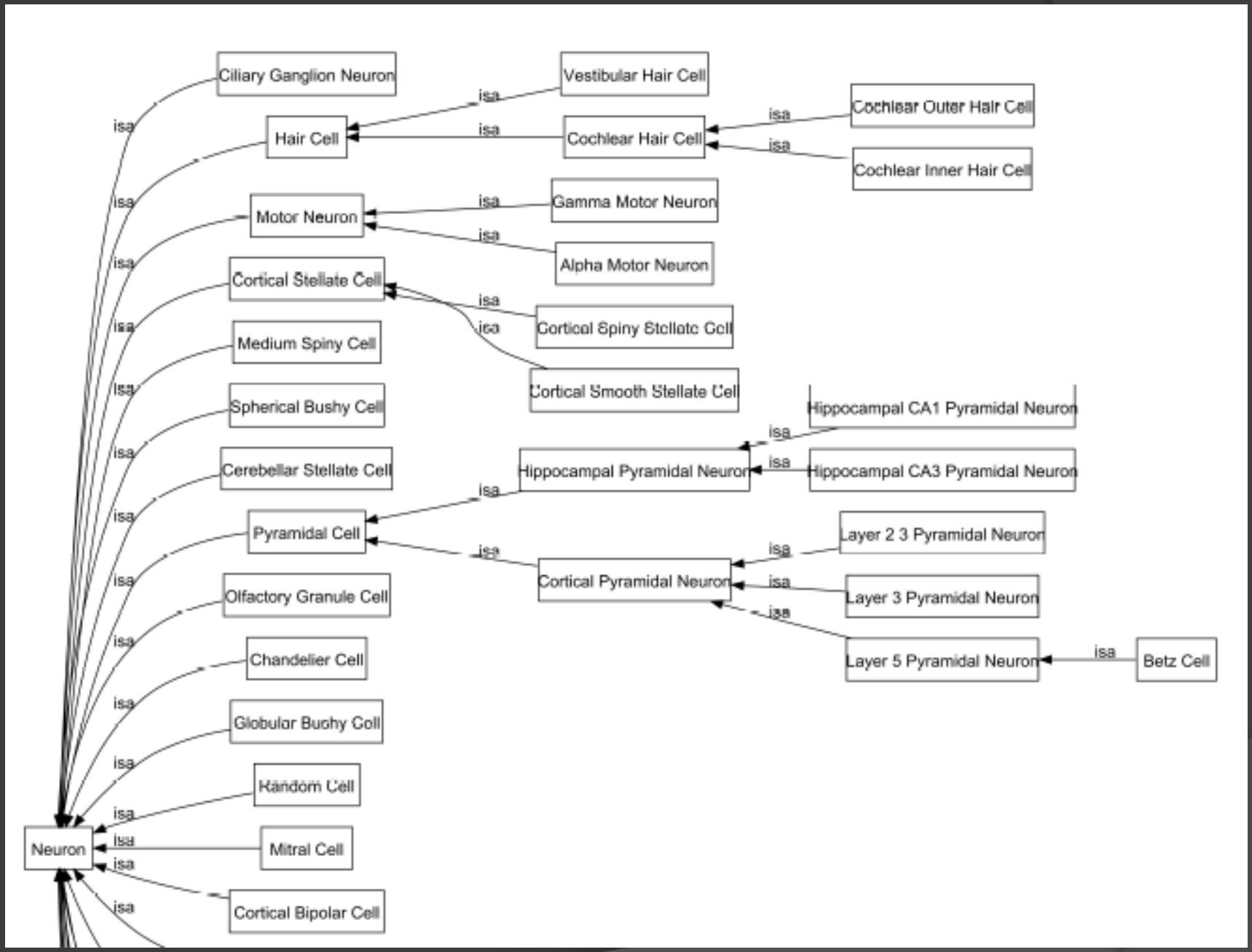
Organizing frameworks for knowledge

Knowledge in words, terminologies and logical relationships (the “what”)

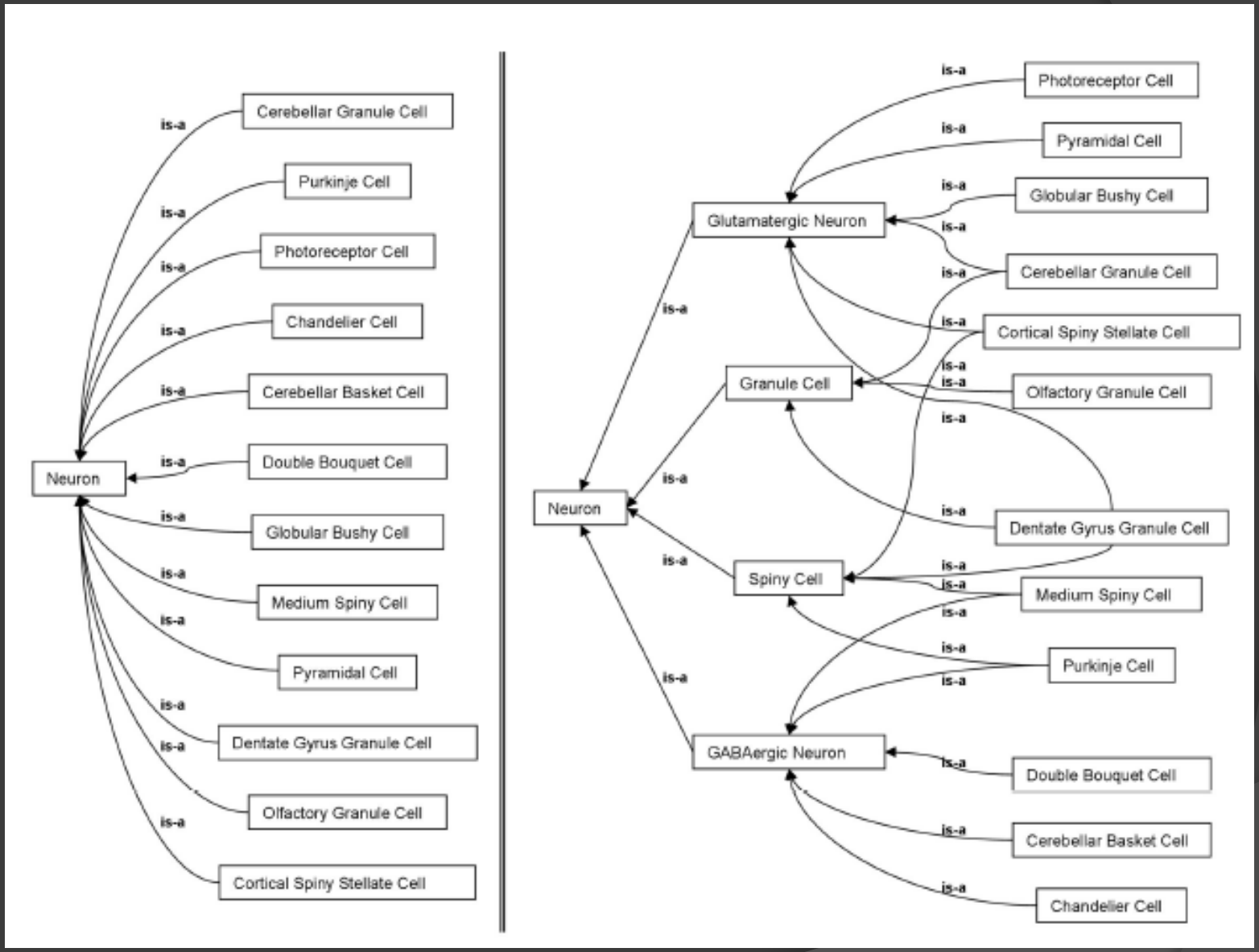
Past

Shared building blocks





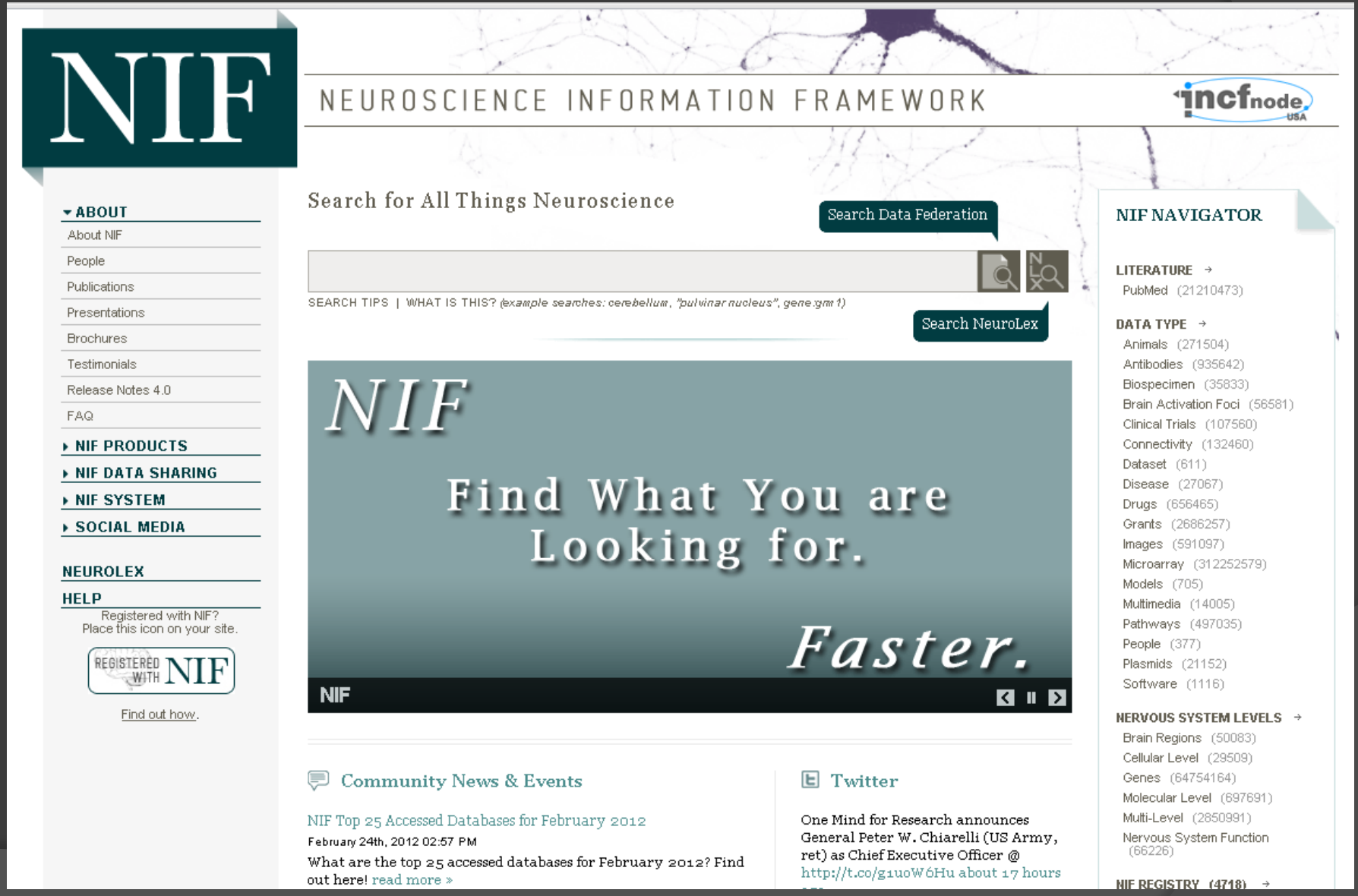
Larson et al., 2007



Larson et al., 2007

Present

Organizing knowledge online



Organizing knowledge online

Top 25 accessed databases in NIF

1. Grants.gov / Opportunity
2. SumsDB / Activation Foci
3. CCDB / All Information
4. Antibody Registry / Abs
5. GENSAT / GENSAT
6. Research Crossroads / Grants
7. BrainInfo /Brain Region
8. Drug Related Gene Database
9. NIF Integrated Nervous System/Connectivity
10. RePORTER / CurrentNIHGrants
11. AllenInstitute / MouseBrainAtlas
12. OneMind / BioBanks
13. ClinicalTrials / ClinTr
14. OMIM / Genes
15. DrugBank / Drugs
16. ModelDB / Models
17. NIF Integrated Animals / Available
18. Gemma / Microarray
19. NIF Integrated Brain Gene/Expression
20. EntrezGene / NCBIGene
21. NIF Integrated Software / Info
22. NIF Integrated Video / Videos
23. GeneNetwork / Info
24. NeuroMorpho / NeuronInfo
25. Human Brain Atlas / Michigan

Need for an online parts list

"We need a parts catalog for the brain" – Society for Neuroscience Keynote lecture, 2009

Parts of Cerebellum

Click the + next to "Cerebellum" to see its parts

- Cerebellum
  - Posterior lobe of the cerebellum
  - Flocculonodular lobe
  - Anterior lobe of the cerebellum
  - Deep cerebellar nuclear complex
  - Cerebellar cortex
    - Climbing fiber
  - Cerebellar Corticopontine Projection
  - Cerebellar Pontocerebellar Projection
    - Cerebellar Serotonergic Afferents
    - Prepositus Nuclear Complex

Larry Swanson, University of Southern California

Inferred incoming projections for Cerebellum

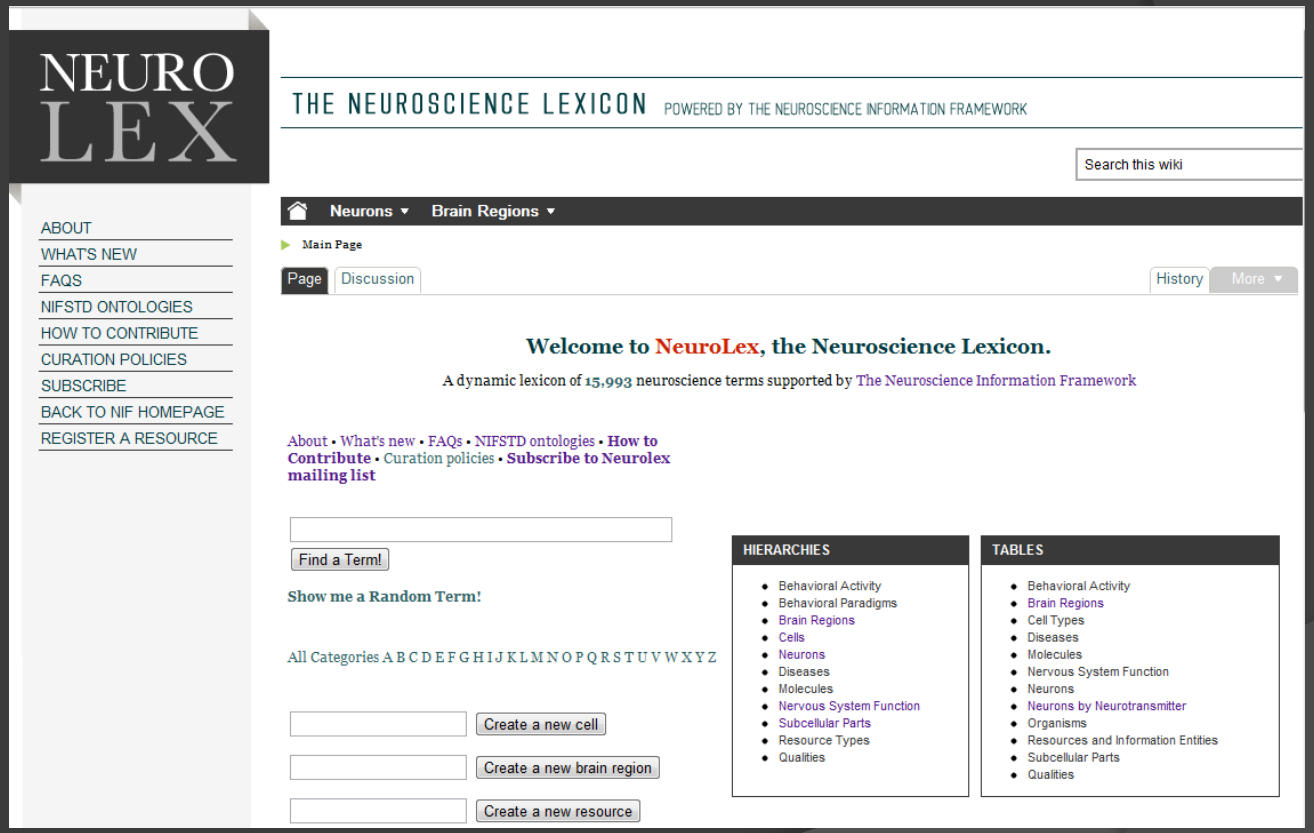
Receives projections from Central cervical spinocerebellar tract, Cerebellar Serotonergic Afferents, Climbing fiber, Posterior spinocerebellar tract, and Rostral spinocerebellar tract

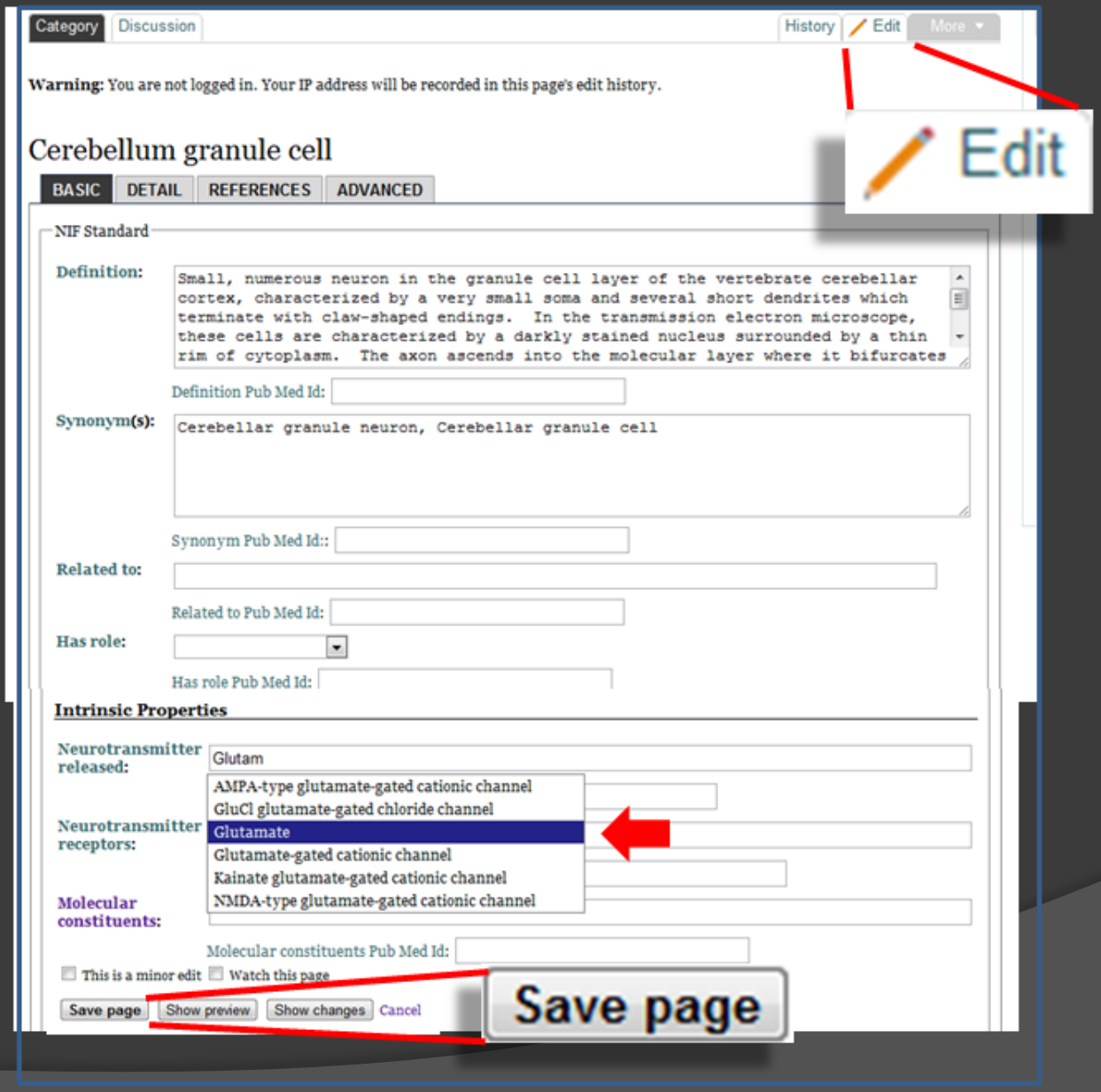
Neurons in Cerebellum

Cerebellum Golgi cell, Cerebellum Lugaro cell, Cerebellum Purkinje cell, Cerebellum basket cell, Cerebellum granule cell, Cerebellum stellate cell, Cerebellum unipolar brush cell, and Golgi II cell are neurons that can be found in Cerebellum or its parts.

Organizing knowledge online

- Built on Semantic MediaWiki
- Uses Semantic Forms to Structured data
- Originally populated from 8-10 community ontologies
- Allows anyone to edit or create new concepts
- ~18,000 concepts




Category
Discussion
History
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Warning: You are not logged in. Your IP address will be recorded in this page's edit history.
Edit
Cerebellum granule cell
BASIC
DETAIL
REFERENCES
ADVANCED
NIF Standard
Definition:
Small, numerous neuron in the granule cell layer of the vertebrate cerebellar cortex, characterized by a very small soma and several short dendrites which terminate with claw-shaped endings. In the transmission electron microscope, these cells are characterized by a darkly stained nucleus surrounded by a thin rim of cytoplasm. The axon ascends into the molecular layer where it bifurcates
Definition Pub Med Id:
Synonym(s):
Cerebellar granule neuron, Cerebellar granule cell
Synonym Pub Med Id::
Related to:
Related to Pub Med Id:
Has role:
Has role Pub Med Id:
Intrinsic Properties
Neurotransmitter released:
Glutam
AMPA-type glutamate-gated cationic channel
GluCl glutamate-gated chloride channel
Neurotransmitter receptors:
Glutamate
Glutamate-gated cationic channel
Kainate glutamate-gated cationic channel
Molecular constituents:
NMDA-type glutamate-gated cationic channel
Molecular constituents Pub Med Id:
This is a minor edit
Watch this page
Save page
Show preview
Show changes
Cancel
Save page

Glutamatergic neuron

C

- Cerebellum granule cell
- Cerebellum unipolar brush cell
- Cochlea hair cell inner
- Cochlea hair cell outer

D

- Dentate gyrus granule cell
- Dorsal root ganglion cell

G

- Gracilis nucleus principal cell

H

- Hippocampus CA1 pyramidal cell
- Hippocampus CA2 pyramidal neuron
- Hippocampus CA3 pyramidal cell

N

- Neocortex pyramidal cell
- Neocortex pyramidal cell layer 5-6

O

- Olfactory bulb (accessory) mitral cell
- Olfactory bulb (main) mitral cell
- Olfactory bulb (main) tufted cell (middle)
- Olfactory cortex large multipolar cell
- Olfactory cortex pyramidal cell
- Olfactory cortex semilunar cell
- Olfactory epithelium main sensory cell
- Olfactory epithelium main supporting cell

R

- Retina bipolar cell
- Retina ganglion cell

S

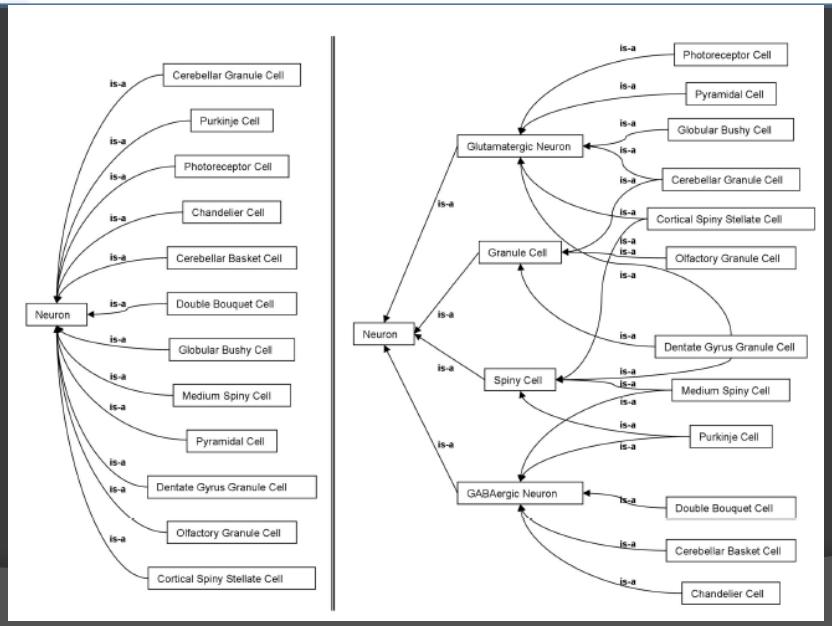
- Spinal cord ventral horn interneuron VoG
- Spinal cord ventral horn interneuron V3
- Subiculum pyramidal cell

T

- Thalamus relay cell

V

- Vestibular ganglion cell
- Vestibular hair cell



Cerebellum neuron

BASIC | ADVANCED | FACTBOX

Name:	Cerebellum neuron
Description:	Neuron whose soma lies in any part of the cerebellum or cerebellar cortex
Synonym(s):	cerebellar cell, cerebellar neuron
Super-category:	Defined neuron class
Id:	nlx_cell_0912002
Link to OWL / RDF:	Download this content as OWL/RDF

Cerebellum granule cell	nifext_128	Cerebellar granule neuron Cerebellar granule cell

Molecular layer of cerebellar cortex

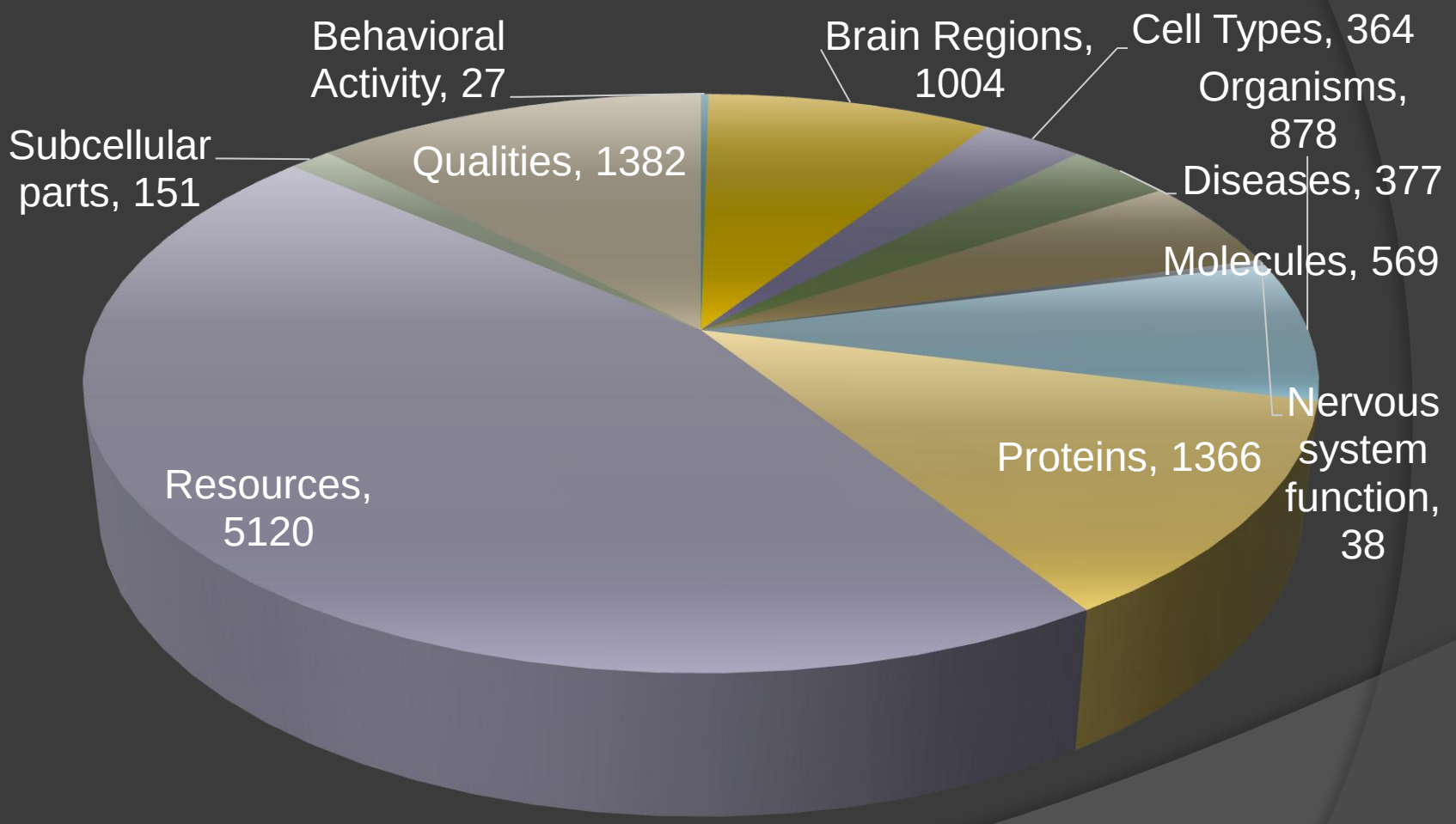
BASIC | ADVANCED | FACTBOX

Name:	Molecular layer of cerebellar cortex
Description:	The term molecular layer of cerebellar cortex is a cytoarchitectural term denoting the most superficial layer of the cerebellar cortex. This layer is characterized by basket and stellate cells. The term plexiform layer of cerebellar cortex is a synonym based on the myeloarchitecture, which consists of thin, densely packed axons coursing parallel to the long axis of the cerebellar folia, delicate terminal axons and rich dendritic ramifications (Carpenter-83).
Is part of:	Cerebellar cortex
Super-category:	Cytoarchitectural part of the cerebellar cortex
Id:	birnlex_810
Defining criteria:	cyto-architecture
Organism:	Mammal
Link to OWL / RDF:	Download this content as OWL/RDF

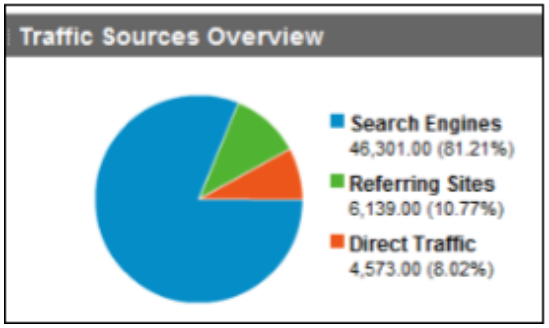
Axons in Molecular layer of cerebellar cortex

Cerebellum granule cell, Cerebellum stellate cell, Climbing fiber are neurons whose axons can be found in Molecular layer of cerebellar cortex or its parts.

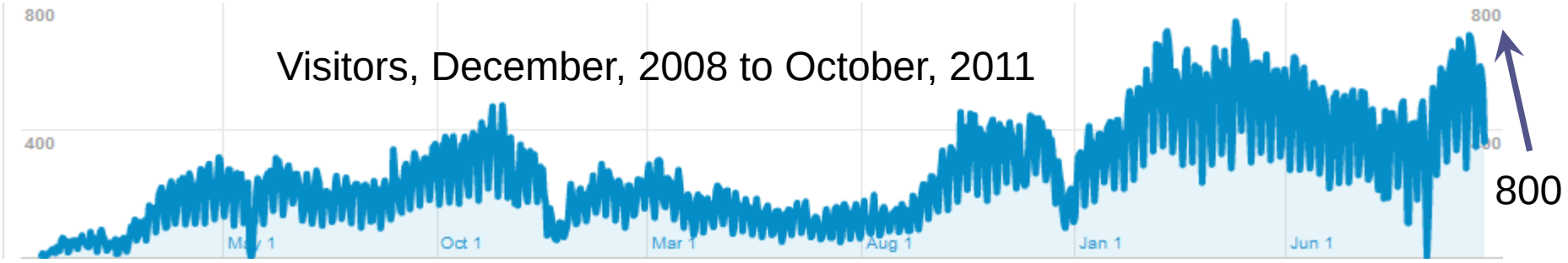
NeuroLex Entities



Organizing knowledge online



Visitors, December, 2008 to October, 2011

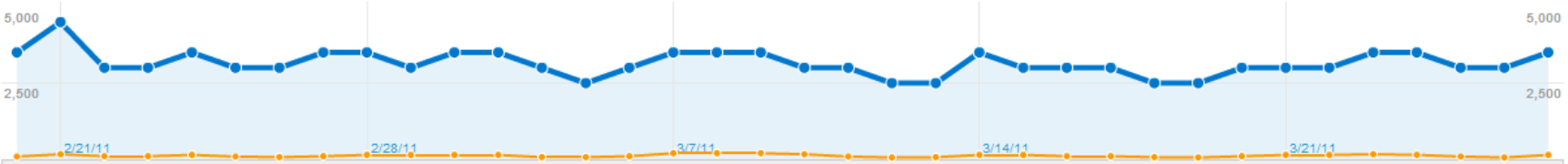


Organizing knowledge online

Search queries

Top queries | Top pages

Filters... Feb 20, 2011 to Mar 27, 2011



Queries	Impressions	Clicks
7,491	800,000 ↑ 78%	15,000 ↑ 50%
	Displaying 95,411	Displaying <10

Query	Impressions	Change	Clicks	Change	CTR	Change	Avg. position	Change
dorsal root ganglion	5,500	↓ -31%	170	↑ 13%	3%	↑ 1.0	4.7	↑ 2.0
neurolex	700	↑ 40%	150	↑ 67%	21%	↑ 3.0	5.0	↓ -2.0
sensory system function	150	↑ 329%	70	↑ ∞	47%	↑ 50	2.4	↓ -0.3
cholinergic neurons	320	↓ -20%	60		19%	↑ 4.0	4.3	↓ -2.0
parafascicular nucleus	250	↑ 1,462%	60	↑ ∞	24%	↑ 20	3.3	↑ 3.0
telencephalon	2,000	↓ -43%	50		2%	↑ 1.0	5.1	↑ 2.0
membrane bound organelles	400	↓ -33%	50	↑ 43%	12%	↑ 7.0	3.9	↑ 2.0
primary olfactory cortex	250	↑ 25%	50	↑ 43%	20%	↑ 3.0	14	↓ -6.0
lateral septum	110	↑ 120%	50	↑ 127%	45%	↑ 1.0	1.4	↑ 0.9
basal forebrain	1,000	↑ 43%	35	↑ 17%	4%	↓ -0.8	9.2	↓ -5.0
nerve cell projections	400	↑ ∞	35	↑ ∞	9%	↑ 9.0	1.0	
sternberg paradigm	70	↓ -53%	35	↓ -42%	50%	↑ 10	1.2	↑ 0.5
cingulate gyrus	3,500	↑ 775%	30	↑ ∞	1%	↑ 0.9	9.7	↑ 2.0
nerve cell projection	1,300	↑ ∞	30	↑ ∞	2%	↑ 2.0	1.0	
dorsal root ganglia	1,300	↓ -19%	30	↓ -40%	2%	↓ -0.8	5.8	↑ 0.9
longitudinal fissure	900	↓ -44%	30	↑ 36%	3%	↑ 2.0	5.7	↑ 0.6
granule cell	250	↑ 47%	30	↑ ∞	12%	↑ 10	13	↑ 10
axon collateral	200	↓ -20%	30	↓ -40%	15%	↓ -5.0	3.1	↓ -0.1
cholinergic neuron	90	↓ -40%	30		33%	↑ 10	10	↓ -2.0

Impact: NeuroLex being found spontaneously online

Hippocampus CA1 pyramidal cell × Search

Google

cholinergic neurons × Search

About 427,000 results (0.10 seconds) Advanced search

Everything
Images
Videos
More

San Diego, CA
Change location

All results
Sites with images
More search tools

Something different
dopaminergic neurons
dopamine neurons
interneurons
glial cells
gabaergic neurons

Cholinergic neuron - NeuroLex
Apr 13, 2010 ... Structured knowledge about **Cholinergic neuron**, which is a Defined neuron class. Date: 4-14-2010.
neurolex.org/wiki/Category:**Cholinergic_neuron** - Cached

Choline and **cholinergic neurons**.
by JK Blusztajn - 1983 - Cited by 291 - Related articles
When **cholinergic neurons** are activated, acetylcholine release can be enhanced by treatments that increase plasma choline (for example, consumption of ...
www.ncbi.nlm.nih.gov/pubmed/6867732 - Similar

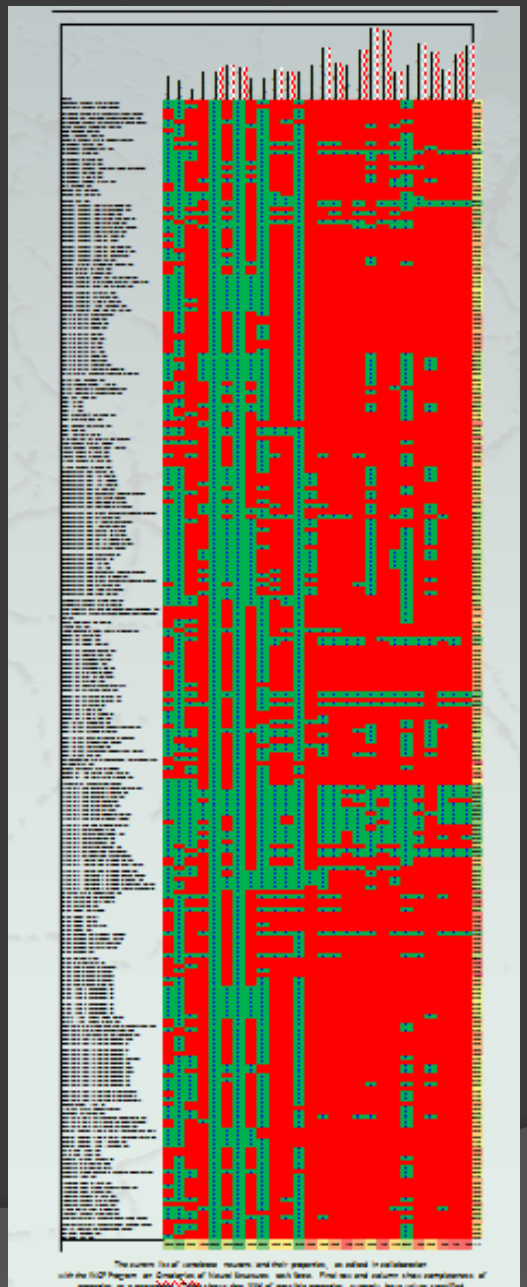
Images for **cholinergic neurons** - Report images

cholinergic neuron - definition of **cholinergic neuron** by the Free ...
Any of the impulse-conducting cells that constitute the brain, spinal column, and nerves, consisting of a nucleated cell body with one or more dendrites and ...
www.thefreedictionary.com/**cholinergic+neuron** - Cached - Similar

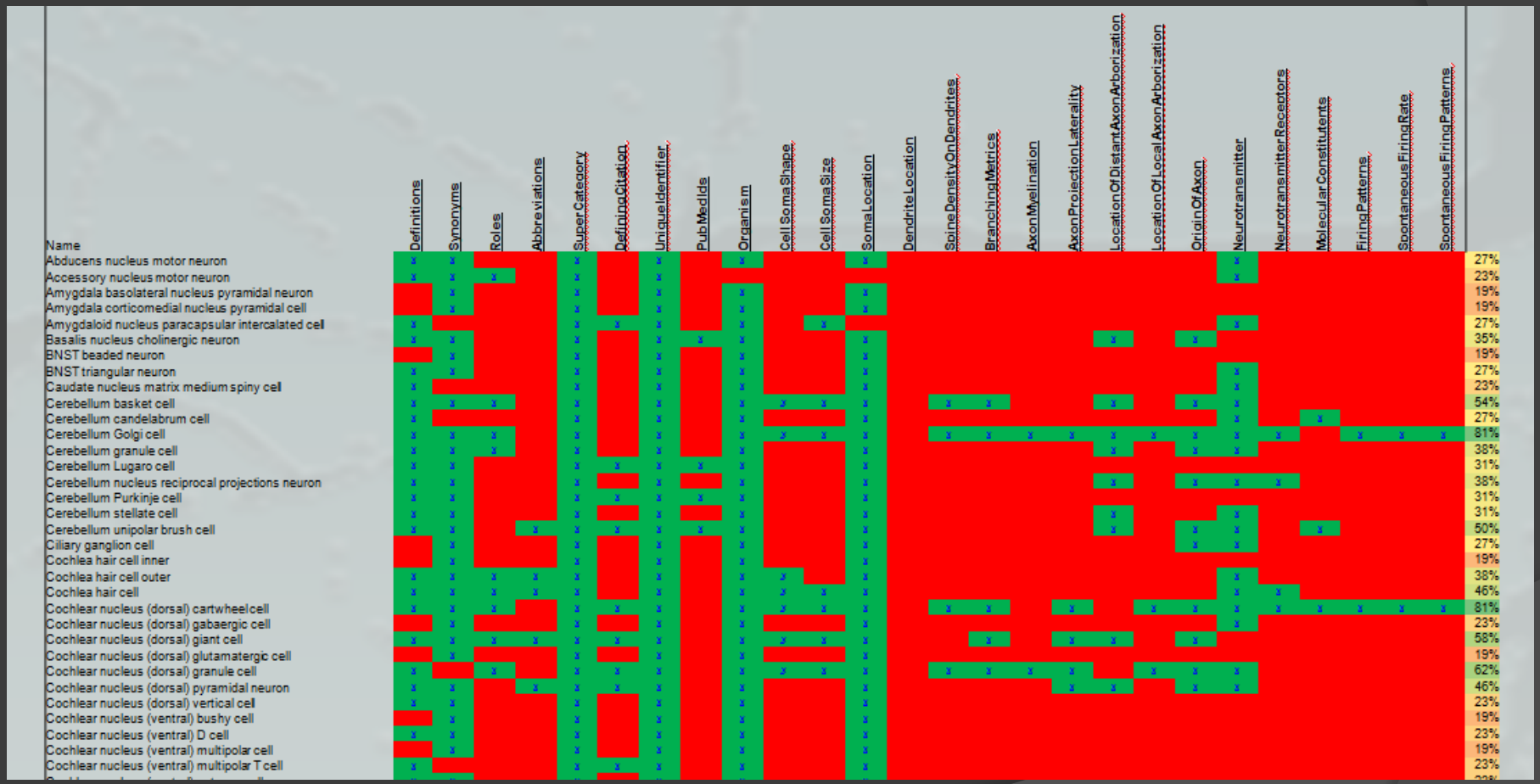
cholinergic neuron - definition of **cholinergic neuron** in the ...
neuron /neu·ron/ (noor´on) nerve cell; any of the conducting cells of the ...
medical-dictionary.thefreedictionary.com/**cholinergic+neuron** - Cached - Similar

Show more results from thefreedictionary.com

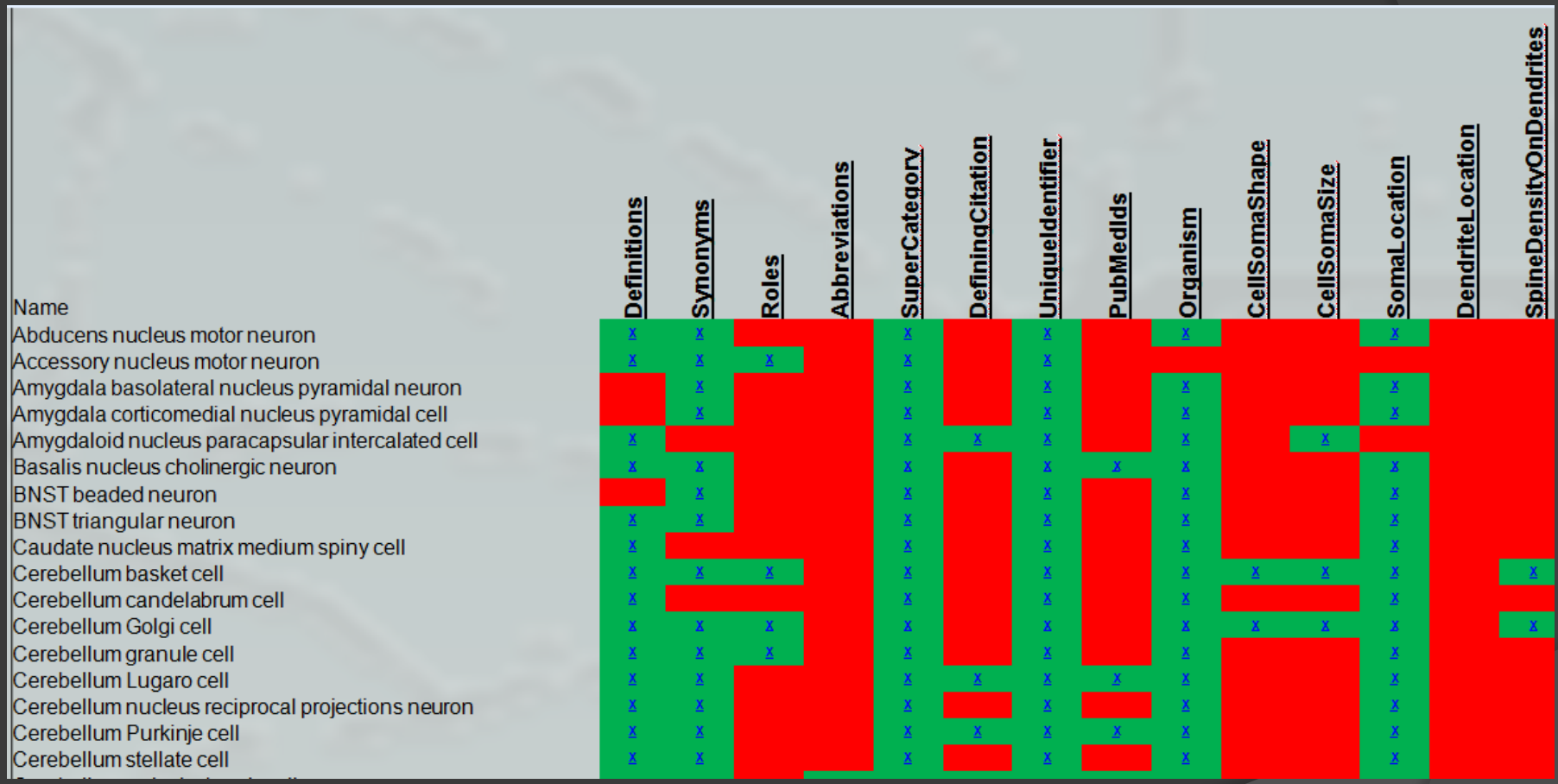
Master table of neurons?



Master table of neurons?



Master table of neurons?



Name	Definitions	Synonyms	Roles	Abbreviations	SuperCategory	DefiningCitation	UniqueIdentifier	PubMedIds	Organism	CellSomaShape	CellSomaSize	SomaLocation	DendriteLocation	SpineDensityOnDendrites
Abducens nucleus motor neuron	x	x			x		x		x			x		
Accessory nucleus motor neuron	x	x	x		x		x							
Amygdala basolateral nucleus pyramidal neuron		x			x		x		x			x		
Amygdala corticomedial nucleus pyramidal cell		x			x		x		x			x		
Amygdaloid nucleus paracapsular intercalated cell	x				x	x	x		x		x			
Basalis nucleus cholinergic neuron	x	x			x		x	x	x			x		
BNST beaded neuron		x			x		x		x			x		
BNST triangular neuron	x	x			x		x		x			x		
Caudate nucleus matrix medium spiny cell	x				x		x		x			x		
Cerebellum basket cell	x	x	x		x		x		x	x	x	x		x
Cerebellum candelabrum cell	x				x		x		x			x		
Cerebellum Golgi cell	x	x	x		x		x		x	x	x	x		x
Cerebellum granule cell	x	x	x		x		x		x			x		
Cerebellum Lugaro cell	x	x			x	x	x	x	x			x		
Cerebellum nucleus reciprocal projections neuron	x	x			x		x		x			x		
Cerebellum Purkinje cell	x	x			x	x	x	x	x			x		
Cerebellum stellate cell	x	x			x		x		x			x		

Every row represents a wiki page that is publicly available for review and edit

Partnerships & Community

NIF NEUROSCIENCE INFORMATION FRAMEWORK

incf International Neuroinformatics Coordinating Facility

Curators with the NIH-funded Neuroscience Information Framework and volunteers with the International Neuroinformatics Coordinating Facility

Community

Contributions

- Described work to represent neuroscience using ontologies
- Provided an introduction to NIF and NeuroLex.org and their use for creating structured data in neuroscience
- Outlined some examples of use of structured data within NeuroLex.org

Acknowledgements

NIF

Maryann Martone (Director)

Jeff Grethe

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Fahim Imam

Vadim Astahkov

Andrea Arnaud

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Larry Lui

Vicky Rowley

Chris Condit

Xufei Qian

Jennifer Lawrence

Willy Wong

Cliff Lee

Lee Hornbrook

Vulcan

Mark Greaves

Wil Smith

Jesse Wang