NeuroScience Associates

2012 calendar

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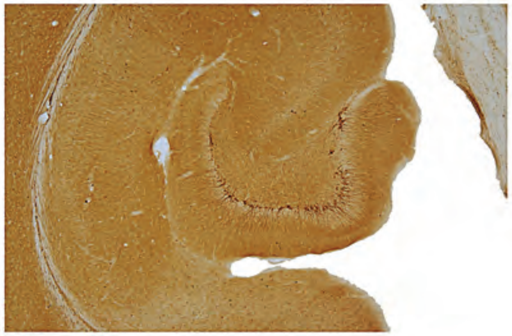
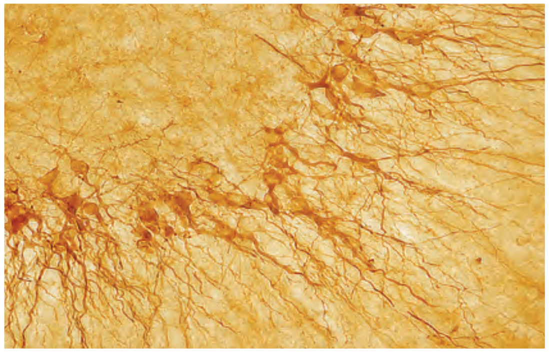


Inset 1

Inset 2



Inset 3

Doublecortin Staining

Immunohistochemical staining for Doublecortin (DCX) in rat brain sectioned in the horizontal plane. Most DCX expression is seen in the subgranular zone of the dentate gyrus (Insets 1-3). DCX has been increasingly used as a marker for neurogenesis, since neuronal precursor cells and immature neurons express DCX while actively dividing. Daughter cells express DCX for 2 - 3 weeks and then begin to express NeuN, a marker more associated with mature cells in the subgranular zone.

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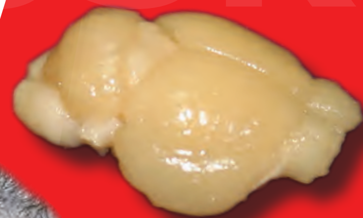
THE MUSK SHREW

The Musk Shrew

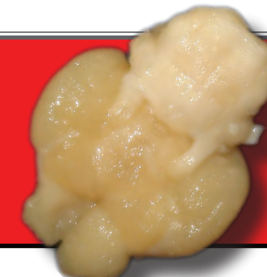
(Suncus murinus)

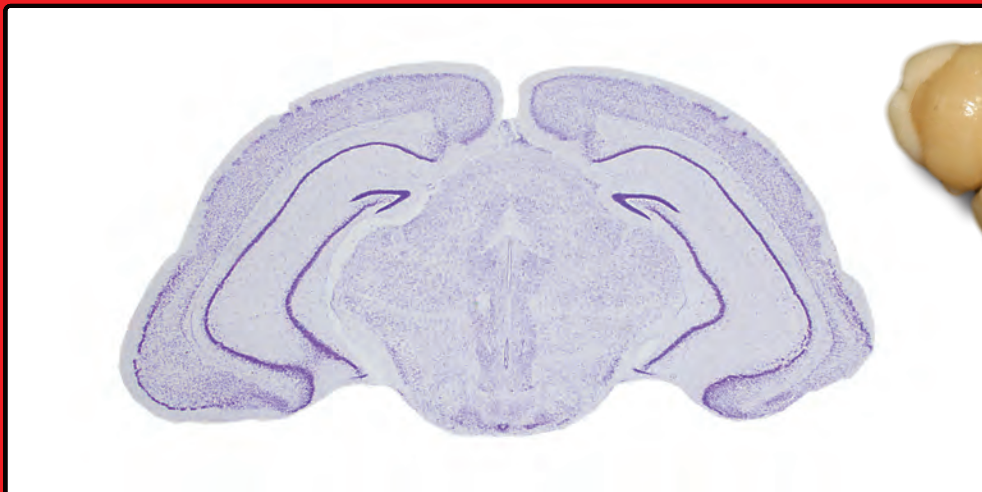
Image of the musk shrew/Asian house shrew by L. Shyamal, Creative Commons License.

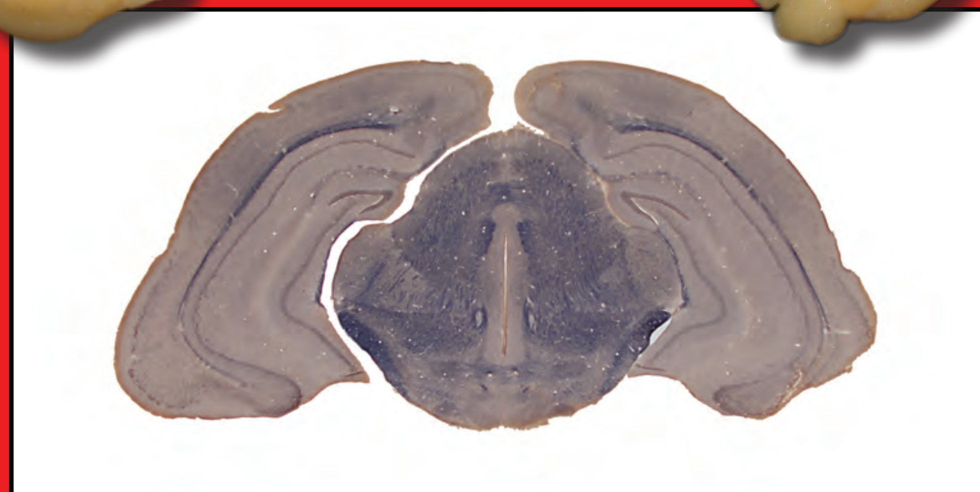


An altricial insectivore with an unusual hormonal profile, the female musk shrew *(Suncus murinus)* has sexual behavior similar to males in other species, due to their lack of an estrous cycle. Musk shrews are rare in the research field but are important because of their evolutionary resemblance to early placental mammals.

Fun Fact: The musk shrew (also called the "Asian house shrew") makes a sound like jangling coins and is sometimes called "the money shrew".



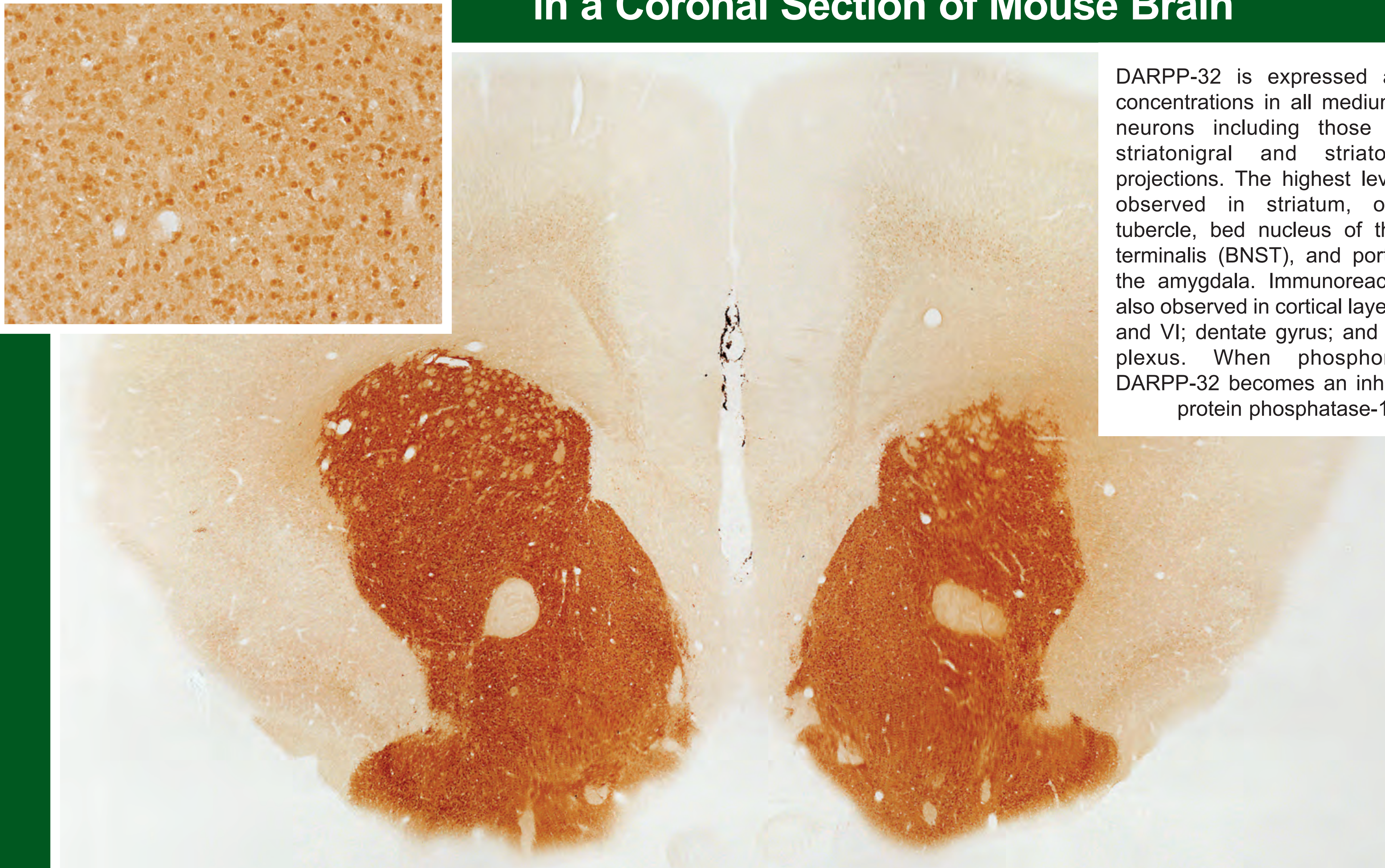




Thionine stain (above) and Myelin stain (right) on Suncus murinus. Images of the brain from various angles are shown (above right).

Special thanks go to Dr. Louise Freeman of Mary Baldwin College for granting permission to use the above images and information.

Distribution of DARPP-32 in Striatum in a Coronal Section of Mouse Brain



DARPP-32 is expressed at high concentrations in all medium spiny neurons including those of the striatonigral and striatopallidal projections. The highest levels are observed in striatum, olfactory tubercle, bed nucleus of the stria terminalis (BNST), and portions of the amygdala. Immunoreactivity is also observed in cortical layers II, III, and VI; dentate gyrus; and choroid plexus. When phosphorylated, DARPP-32 becomes an inhibitor of protein phosphatase-1.

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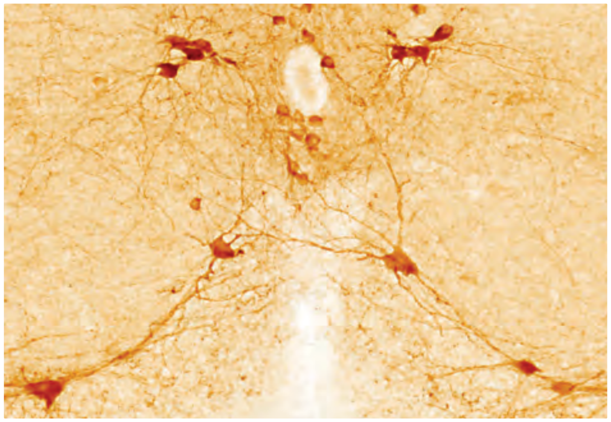
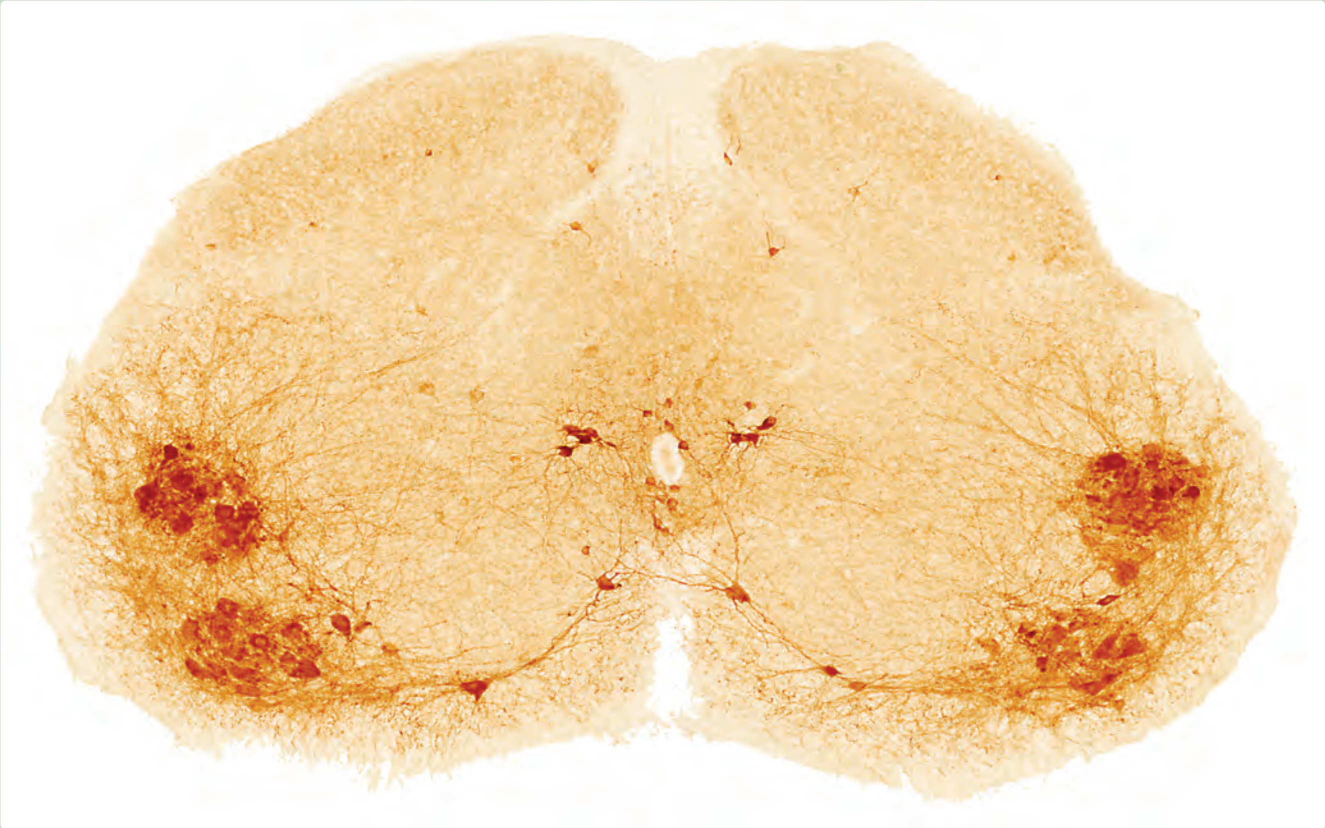


ChAT

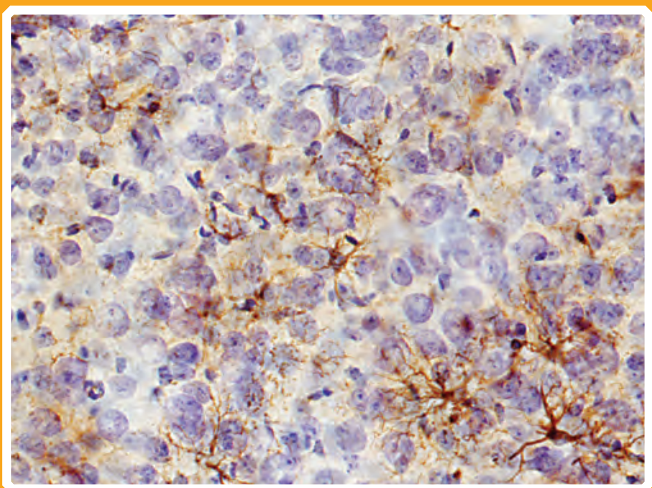
Choline acetyltransferase (ChAT) immunohistochemical staining is shown in mouse spinal cord. The ChAT enzyme is synthesized in the cell body and transported to the nerve terminal. ChAT plays a role in the formation of acetylcholine, a neuro-transmitter in the central nervous system as well as in the autonomic nervous system.

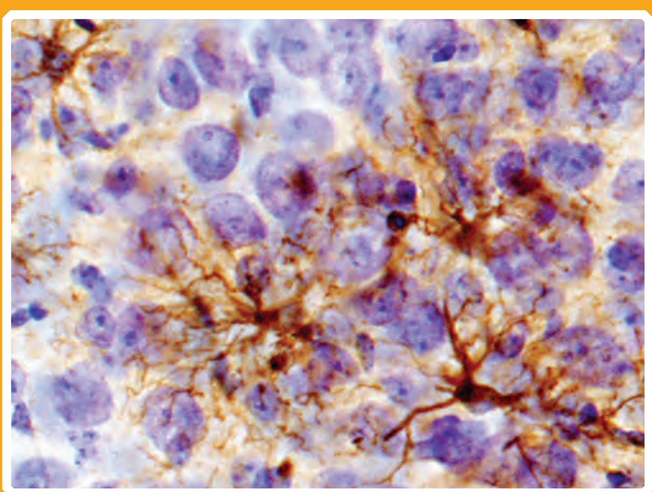


GFAP

GFAP With Thionine Counterstain

Glial fibrillary acidic protein (GFAP) is an intermediate filament specific to astrocytes, and was used to demonstrate this population of neuroglia in mouse brain. Sections were counterstained with Nissl (Thionine) to reveal the entire cellular population of the brain.





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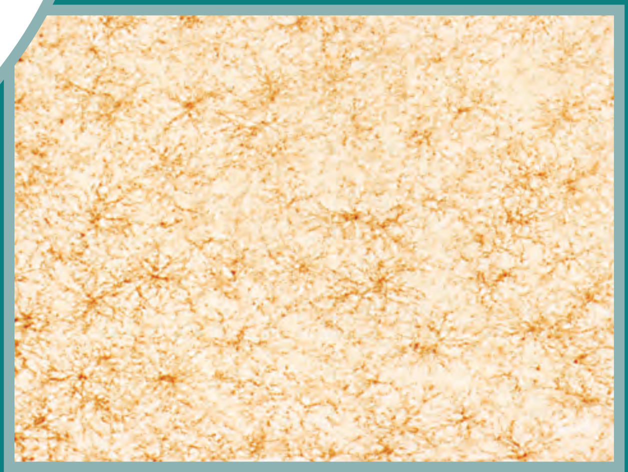
NG2 GLIA



Immunohistochemical demonstration of nerve/glial antigen-2 (NG2) glia. In the normal central nervous system (CNS), these cells are oligodendrocyte precursors. In injury, they may also produce Schwann cells and possibly astrocytes.

Insets (upper right and right): NG2 glia in hippocampus and cortex.

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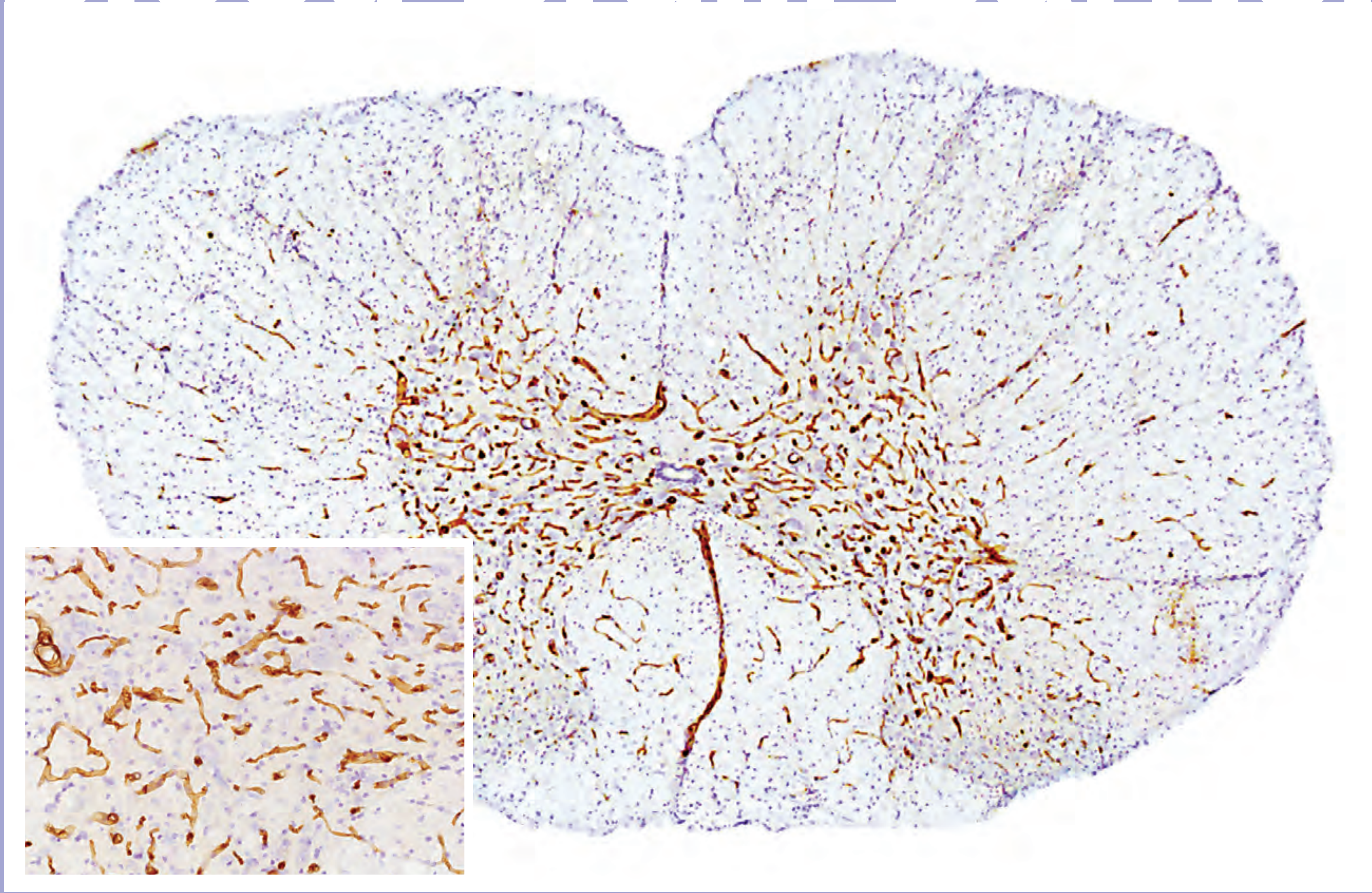
Blood Brain Barrier



Immunohistochemical detection of protein endothelial barrier antigen using the antibody SMI-71 demonstrates an intact blood brain barrier (BBB). Loss of staining of the endothelial barrier antigen corresponds to disruption of the BBB.

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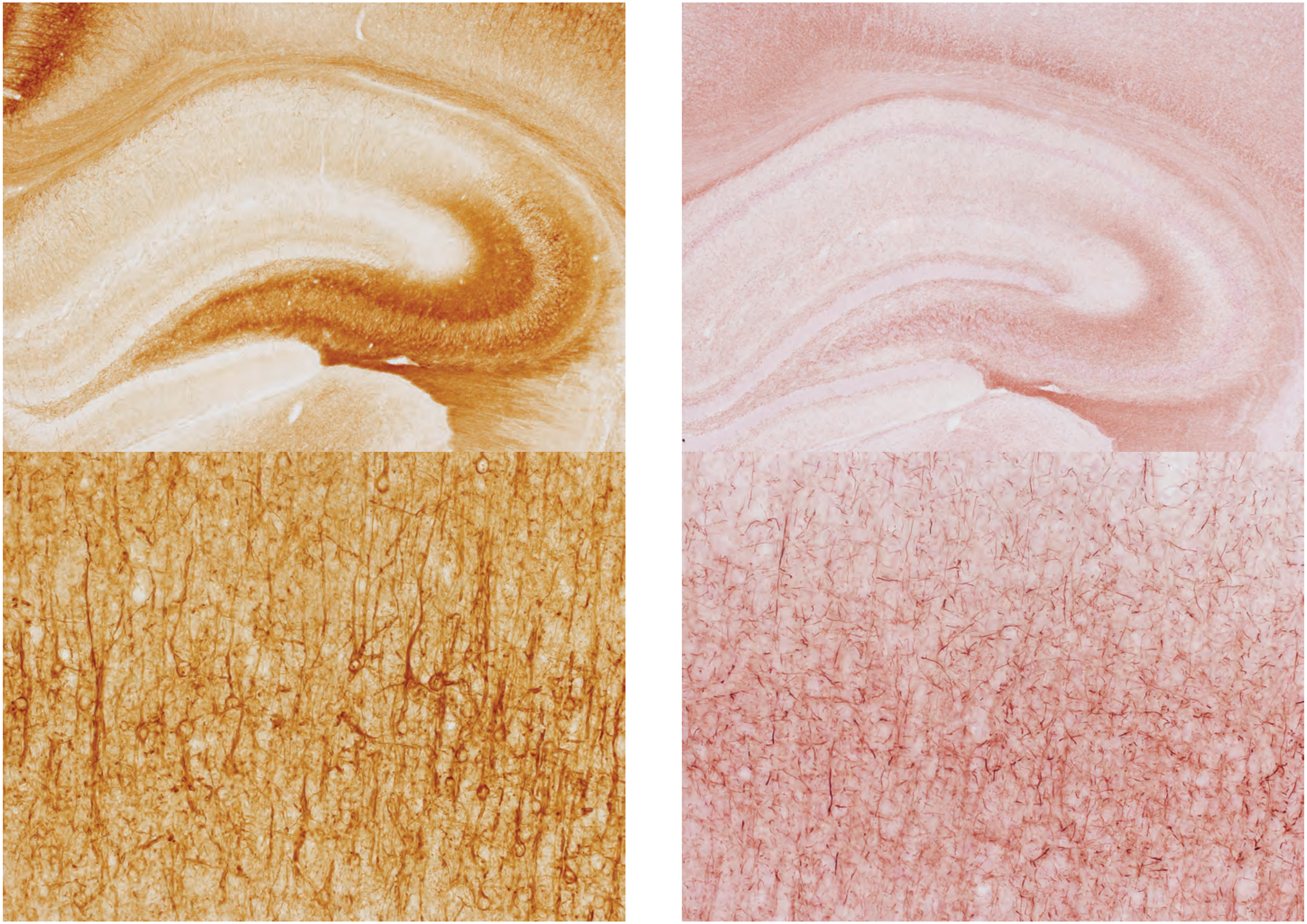
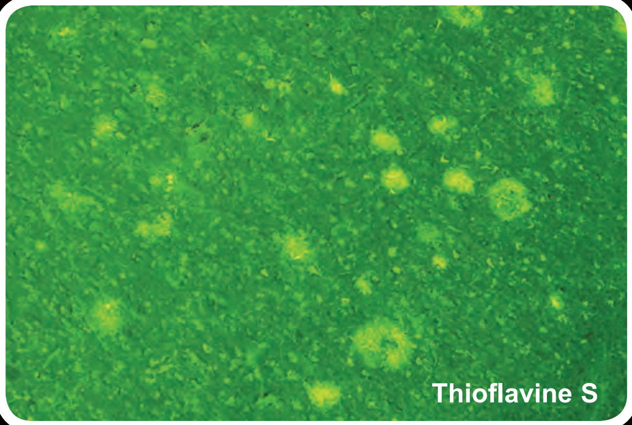
SMI-311, 312

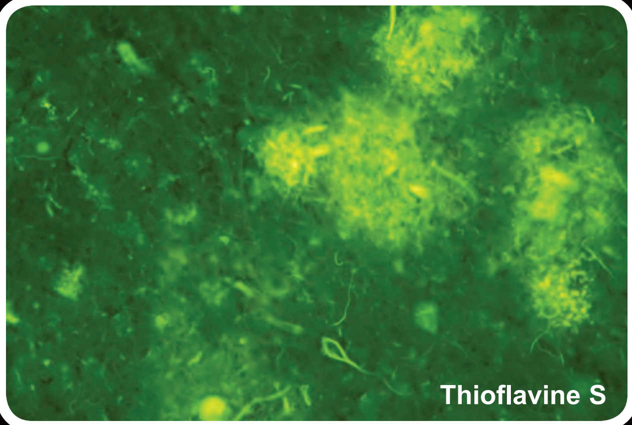


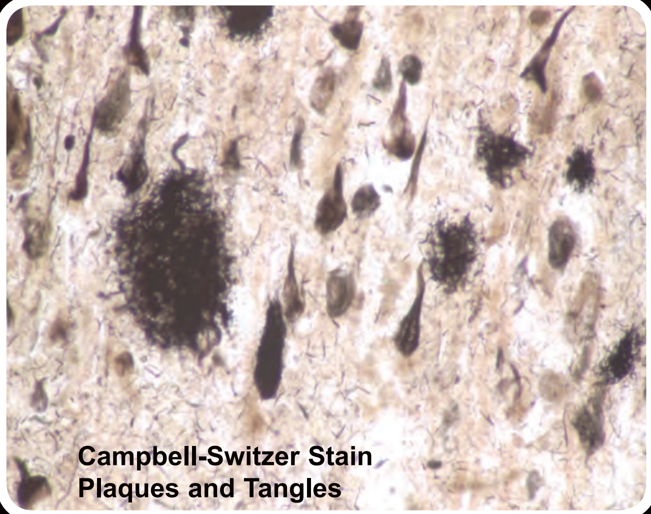
Antibody staining of neurofilaments in rat brain. SMI-311 (brown) stains non-phosphorylated neurofilaments and specifically reveals cell bodies and dendrites. SMI-312 (red) stains highly phosphorylated neurofilaments of axons. Low-magnification images of hippocampus reveal distributions of phosphorylated and nonphosphorylated neurofilaments. High-magnification images of cortex reveal staining in different parts of the neuron by the two antibodies. (Antibody source: Covance.)

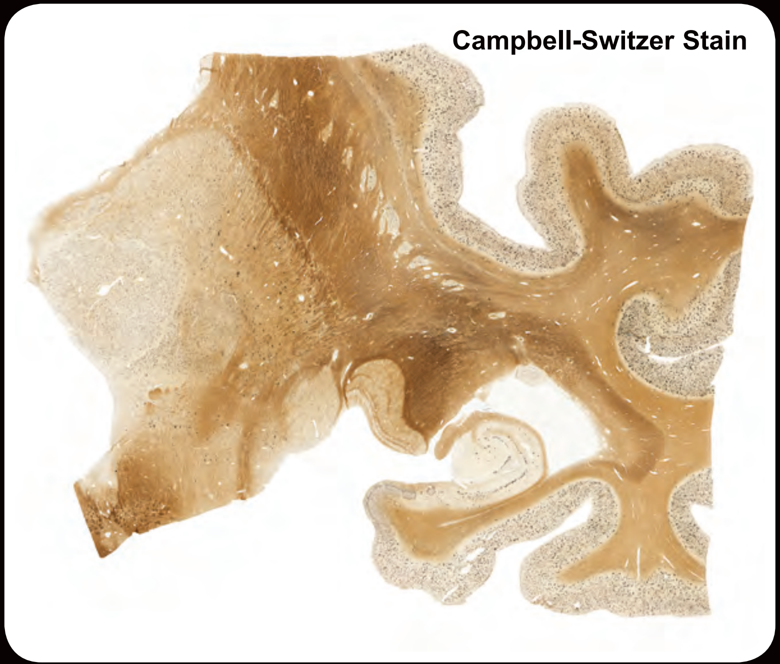
Alzheimer's Pathology

As expressed in a human female, age 69









Attributes of neuritic plaques and neurofibrillary tangles. Cognitive symptoms in this patient appeared at age 60, with advanced stage symptoms setting in by age 65. Green insets show fibrillar amyloid stained with Thioflavine S. The Campbell-Switzer stain reveals both fibrillar amyloid in mature plaques and beta amyloid in diffuse plaques as well as the neurofibrillary tangles in neurons.

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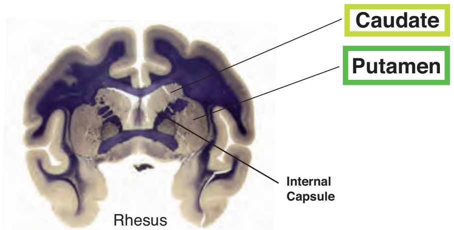
Phylogenetic Comparision of Volume Ratios of Caudate and Putamen

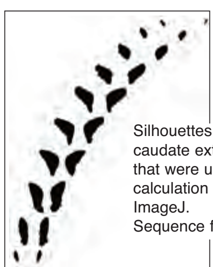
M. L. Whitson, J. A. Baun, *R. C. Switzer III; NeuroScience Associates, Knoxville, TN 37934



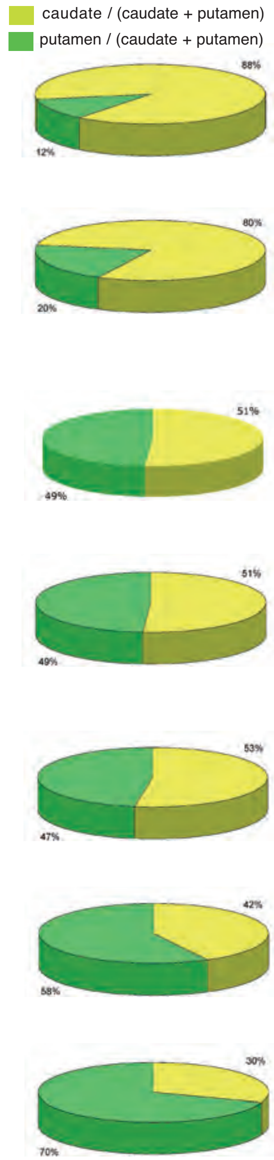
Coronal sections through the forebrain of primate brain display a familiar view of the internal capsule separating the caudate and putamen. A cursory review of images from diverse species found in the website http://brainmuseum.org/sections/index.html, indicates that most mammals have this characteristic feature with the exception of animals such as rats and mice. The presence of a caudate separated by the internal capsule from the putamen does not appear to be a function of gyrencephaly or lissencephaly nor of mere size.

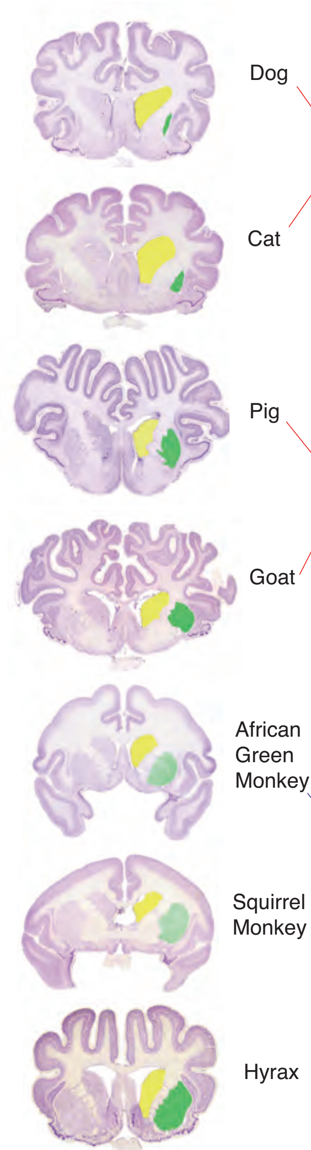
A further comparison of the different species leaves the impression that in some animals, such as dog, the caudate is much larger than the putamen, whereas in primate the two are more equitable. To determine if this difference was illusory or real, the ratio of the volumes of putamen and caudate were determined from sections from the brains of dog (beagle; *Canis familiaris*) and of a primate (African Green monkey; *Cholorocebus sabaceus*). The impression was confirmed and the study was extended to include other species for a better phylogenetic representation. Images of brain section images from the brainmuseum.org website for goat, cat, hyrax and squirrel monkey were used for volume calculations. Images of the pig brain were derived from NSA's slides.

Sections stained for nissl substance and myelin were used to delineate and measure the areas (Image J) of putamen and caudate in a series of uniformly spaced slides from the rostral to caudal limits of both structures. Using Simpson's approximation formulae the volumes for each structure were determined and ratios calculated.



Silhouettes rostral to caudal of blackened caudate extracted from captured images that were used for area and volume calculation using thresholding methods in ImageJ.
Sequence from Dog brain.

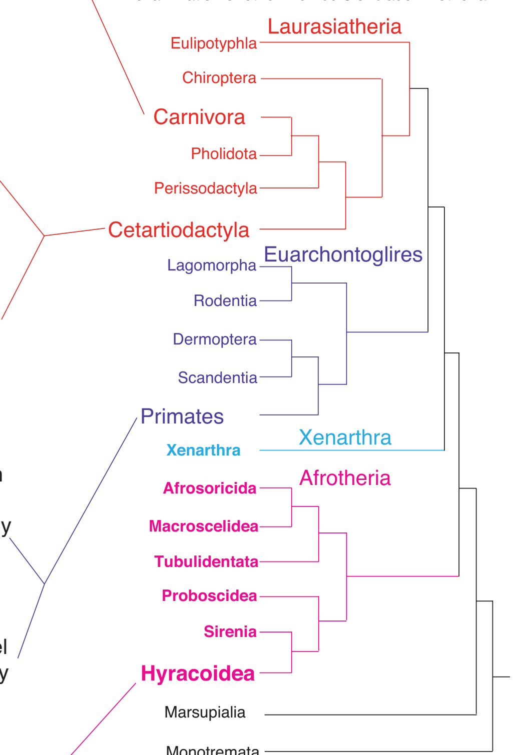




The molecular based tree of the 4 clades of placental mammals is shown in different colors. The animals examined are representative of 3 of the 4 clades.

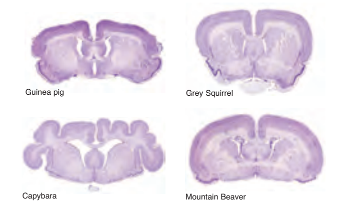
Diminutive proportional size of the putamen to the caudate in cat and dog seems unique within this sampling even within the same clade, Laurasiatheria. Examination of other carnivores as well as other species across all clades should reveal the extent of this uniqueness.

The opposite proportion of putamen greater than caudate occurs in hyrax and warrants further examination of other members of clade Afrotheria.



Phylogenetic tree redrawn from Figure 1 Springer et.al. Trends in Ecology and Evolution, vol.19 August 2004, 430-437.

Rodents' internal capsule:
to coalesce or not to coalesce
to create a Caudate and Putamen



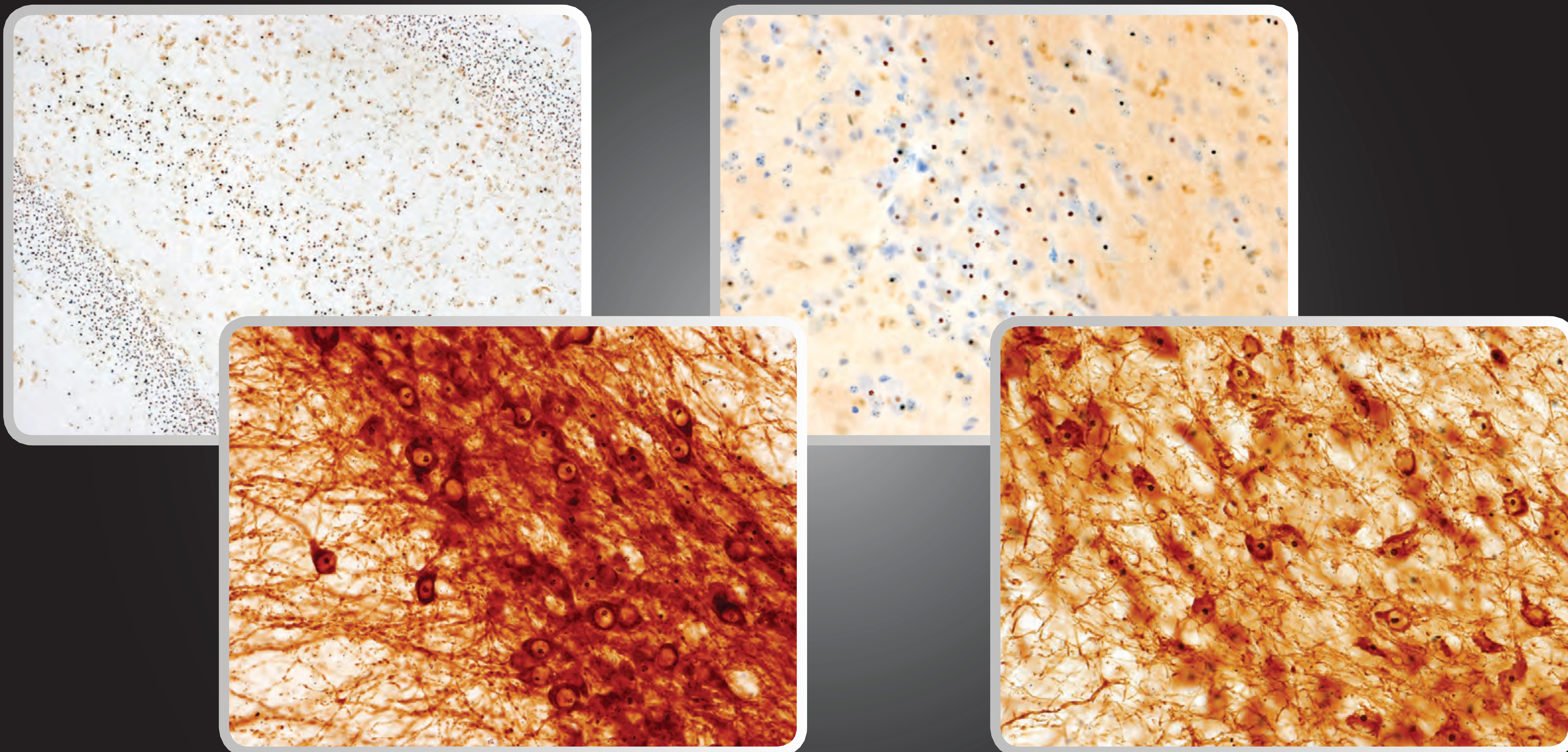
Caudate and putamen are collectively known as striatum and receive input from most of cortex, but with regional differences. It is perhaps such differences that govern the dynamics of brain development and determine just where the components of the internal capsule will coalesce and divide caudate from putamen as occurs in most species or does not as in rats and mice.

Similar 'forces' may be at play in deciding how cortex is folded and have been discussed by Welker et. al. (Welker W. Why does cerebral cortex fissure and fold? A review of determinants of gyri and sulci. Jones EG, Peters A, eds. (1990) Vol. 8b. New York: Plenum Press. 3–136. Cerebral cortex).

Other instances of fiber pathway variations have been observed that follow phylogenetic groupings. (Switzer, R.C., Johnson, J.I. and Kirsch, J.A.W.: Phylogeny through brain traits: The relation of the lateral olfactory tract fibers to the accessory olfactory formation as a palimpsest of mammalian descent. Brain, Behavior and Evolution 17: 339-363, 1980).

We would like to dedicate this study to Wally Welker, University of Wisconsin, whose devotion and work has been a cornerstone for comparative neuroanatomy. Without the fruits of his work, studies such as this would not be possible.
W.I. Welker 1926-2007

Silver Nucleolar Stain



A silver staining technique used to reveal AgNOR particles was modified to allow visualization of nucleoli. A size difference is observed among nucleoli in the granule cells of the dentate gyrus and hilar neurons (upper left). Nissl counterstaining defines the cell body and aids in identification of location (upper right). In thick sections prepared for stereology using tyrosine hydroxylase immunohistochemistry, the nucleolus provides a superior "counting unit" to the nucleus (lower left). Stereological analysis is enhanced by nucleolar staining in a model of Parkinson's disease (lower right).

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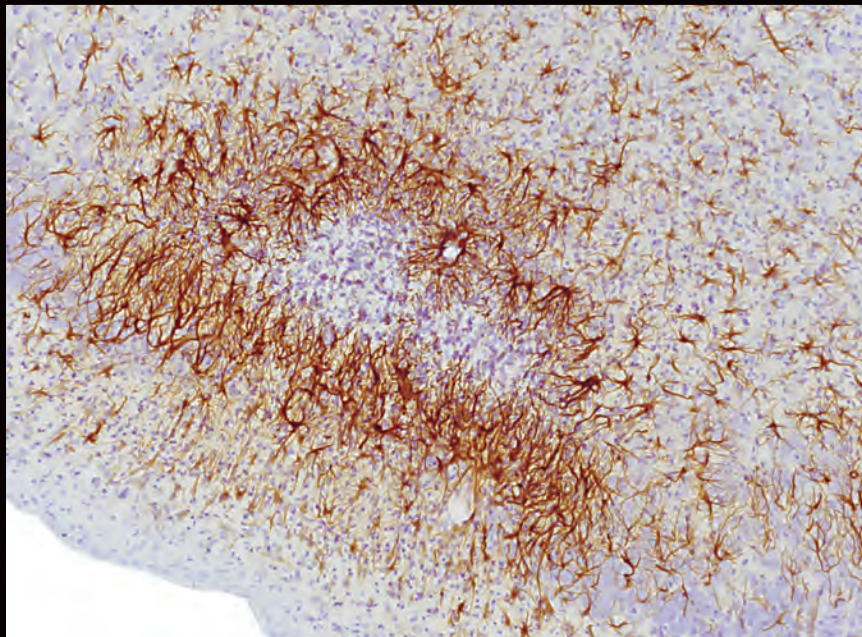
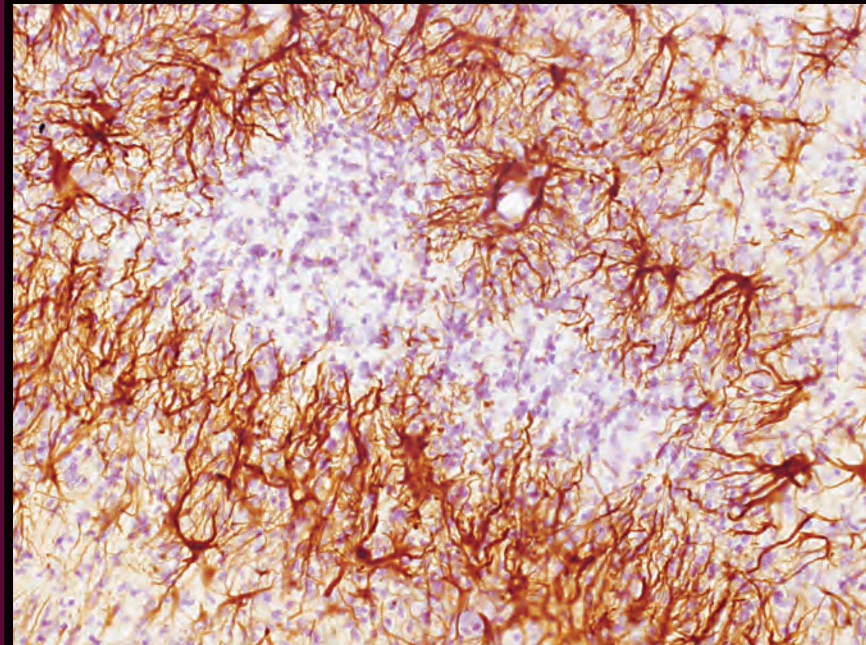
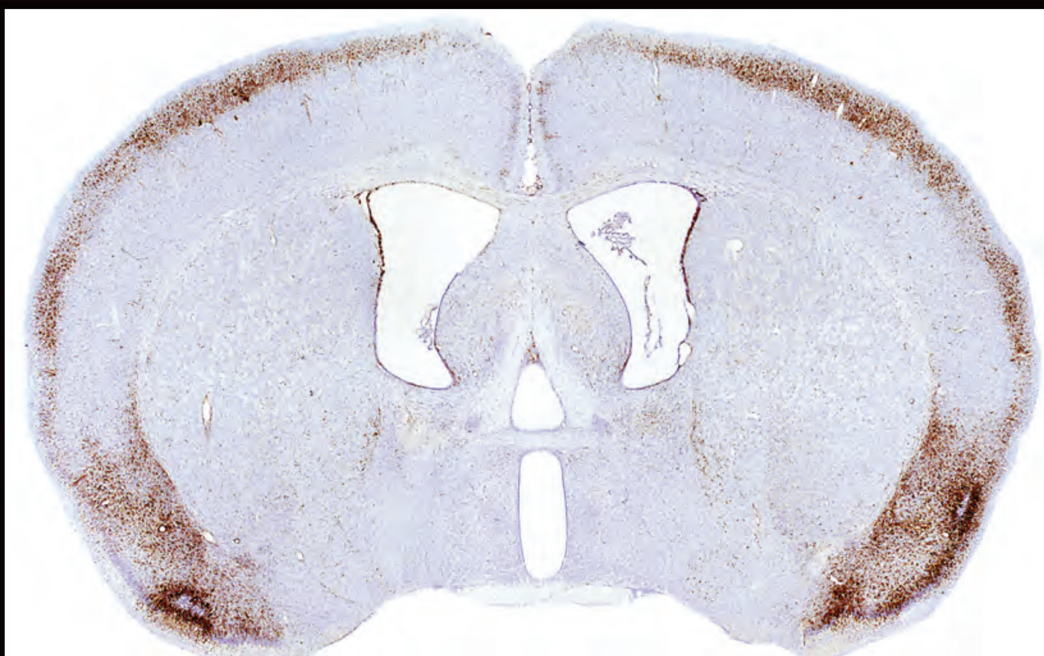
Nestin Immunohistochemistry







Nestin staining for astrocyte reactivity in mouse cortex is shown. Only astrocytes in the reactive state express Nestin, unlike GFAP which is expressed by astrocytes in both the resting and the activated states. This makes nestin a useful tool for identifying activation states for astrocytes because of injury, inflammation, or disease.

Pioneers in Neuroscience: Dr. John I. Johnson

John "Jack" I. Johnson, PhD and professor at Michigan State University, has long been a pioneer of the field of neuroscience. First receiving his AB from Notre Dame and both MS and PhD from Purdue University, Dr. Johnson went on to teach at Marquette University, University of Wisconsin, University of Sydney (Australia), and Michigan State University (MSU). With his primary research interest in the evolution of brains in vertebrates, Dr. Johnson continues to serve the neuroscience field in many ways, including as a professor of anatomy at MSU and as a primary contributor to the online reference source brainmuseum.org.

From Dr. Bob Switzer, CEO and President, NeuroScience Associates: Early in my graduate school years in the biophysics department at Michigan State, I had the good fortune of meeting Jack. By introducing me to the wondrous world of comparative neuroanatomy, he gave me insights and perspectives that are still with me - as they are with the many other students that experienced Jack's tutelage. At first a mentor and now a friend and colleague, Jack continues to influence my thinking and career. All who know Jack come away feeling privileged to have met him.

Thank you, Jack, for your positive influence and encouragement in the field of comparative neuroanatomy.