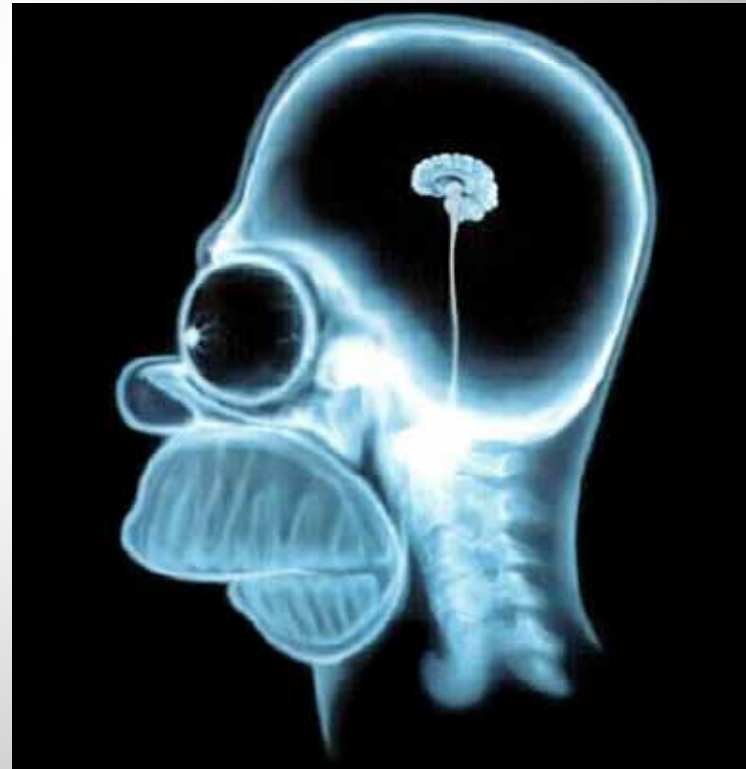
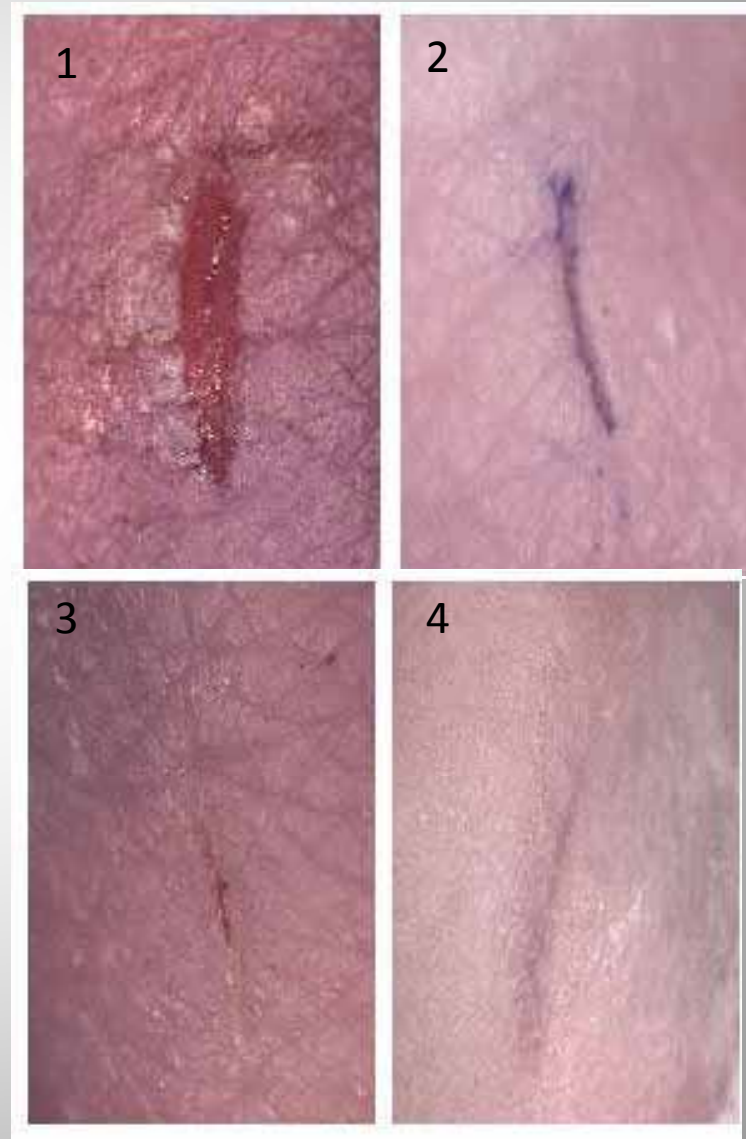


Songbirds, Steroids and Adult Neurogenesis



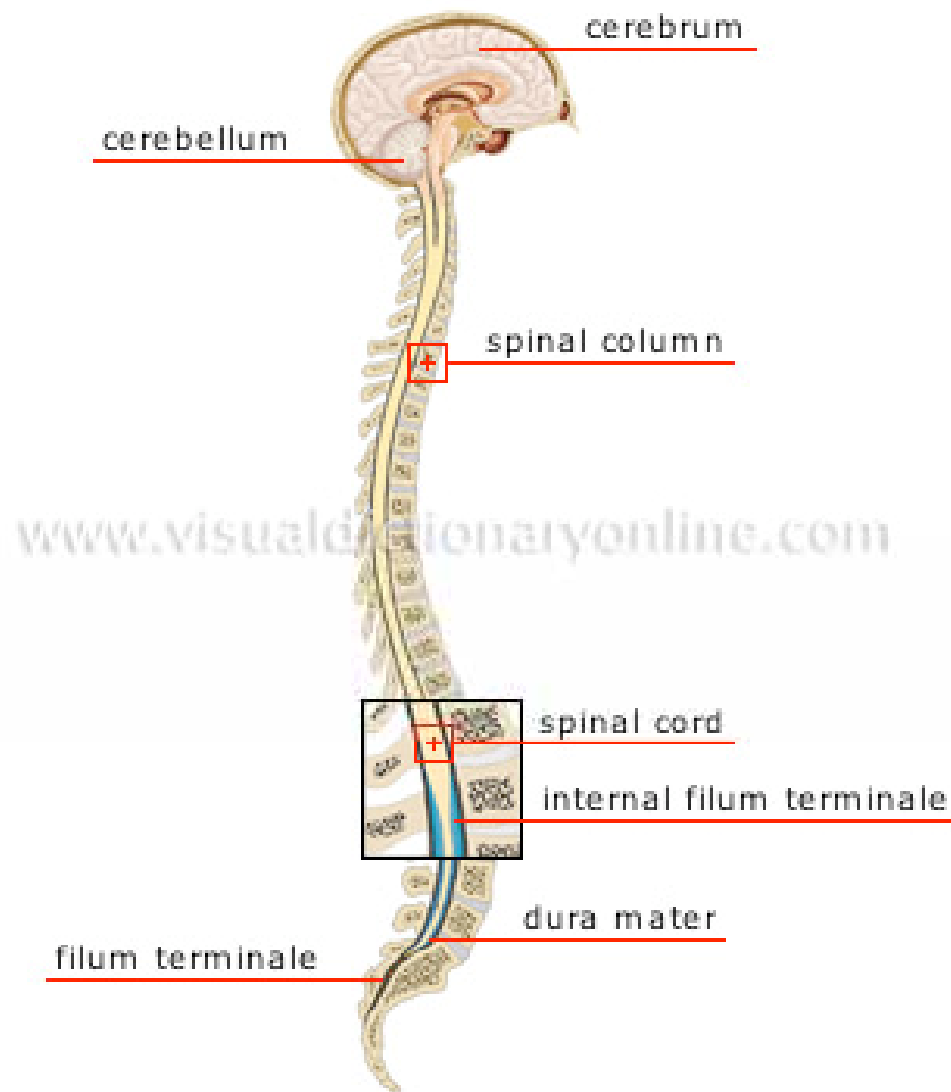
Some tissues Regenerate



<http://flickr.com/photos/museumoflondon/2392340925/>

<http://www.anat.ucl.ac.uk/business/becker1.shtml>

While some tissues do not...



While some tissues do not...



<http://commons.wikimedia.org/wiki/Image:MCAO-sheep.jpg>

While some tissues do not...

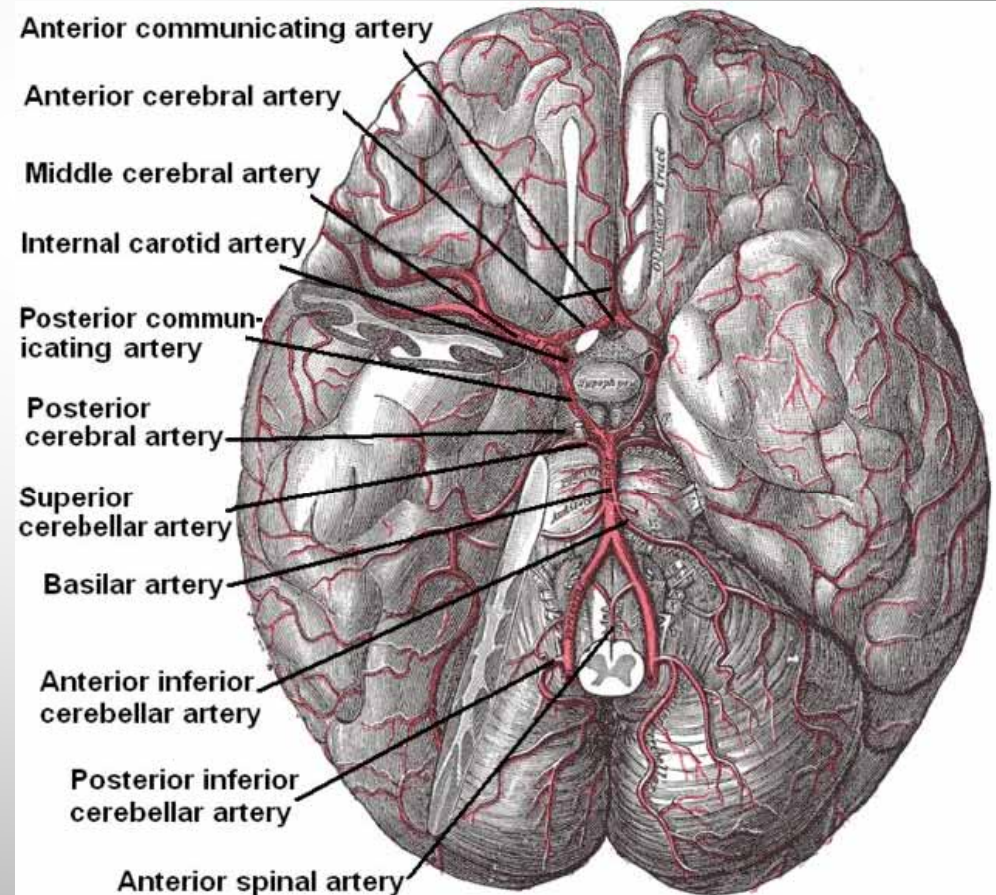


MCAO: Middle cerebral artery occlusion
Mechanism for producing cerebral ischemia

IN OTHER WORDS:
STROKE

<http://commons.wikimedia.org/wiki/Image:MCAO-sheep.jpg>

http://en.wikipedia.org/wiki/File:Arteries_beneath_brain_Gray_closer.jpg



Some causes of neural damage



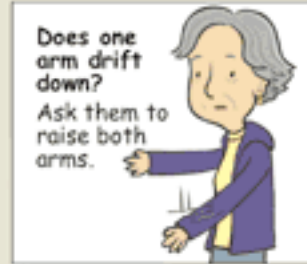
Face



Does the face look uneven?
Ask them to smile.



Arm



Does one arm drift down?
Ask them to raise both arms.

Speech



Does their speech sound strange?
Ask them to repeat a phrase.

Time



Every second brain cells die. Call 9-1-1 at any sign of stroke!

Is it a stroke?

Check these signs FAST!

Call 9-1-1 at any sign of stroke.

Massachusetts Department of Public Health — For more information call 1-800-487-1119 or email heart.stroke@state.ma.us

Stroke Heroes Act FAST!

Some causes of neural damage



Some causes of neural damage

Dead athletes' brains show damage from concussions

BRAIN DAMAGE

January 26, 2009 | By Stephanie Smith CNN Medical Producer

For years after his NFL career ended, Ted Johnson could barely muster the energy to leave his house.

"I'd [leave to] go see my kids for maybe 15 minutes," said Johnson. "Then I would go back home and close the curtains, turn the lights off and I'd stay in bed. That was my routine for two years.

"Those were bad days."

WVU doctors: Chris Henry had chronic brain injury

By VICKI SMITH, Associated Press Writer Jun 28, 2:02 pm EDT

Chris Henry was 26 years old at the time of his death



RUSTY98UM

Some causes of neural damage



San Antonio Express-News/AP

The American Association of Neurological Surgeons say that 90% of boxers sustain a brain injury.

Punch-Drunk Boxers

The condition, which occurs in boxers who have suffered repeated blows to the head:

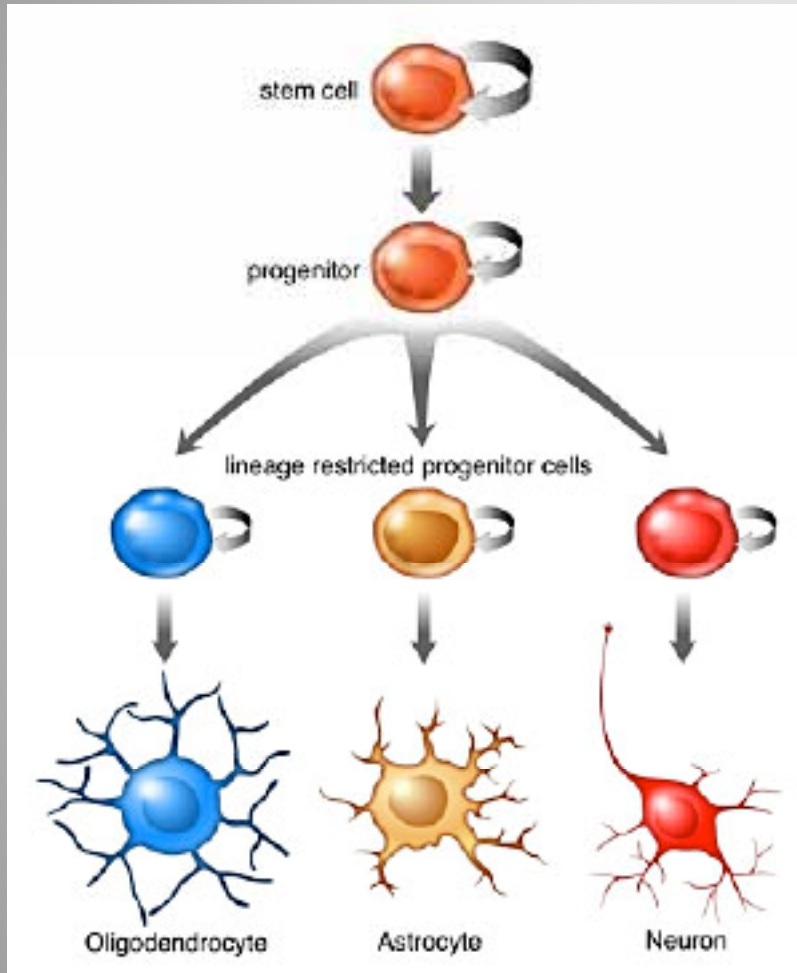
Symptoms:

- 1) Dementia, or declining mental ability
- 2) Problems with memory and parkinsonism
- 3) Tremors and lack of coordination
- 4) Speech problems
- 5) Unsteady gait
- 6) Inappropriate or explosive behavior

The brains of DP patients atrophy and lose neurons, scarring of brain tissue.

Sufferers may be treated with drugs used for Alzheimer's disease and parkinsonism.

What is Neurogenesis?



Neurogenesis (birth of neurons) is the process by which neurons are generated.

Most active early in life

For years, thought to not happen at all later in life.

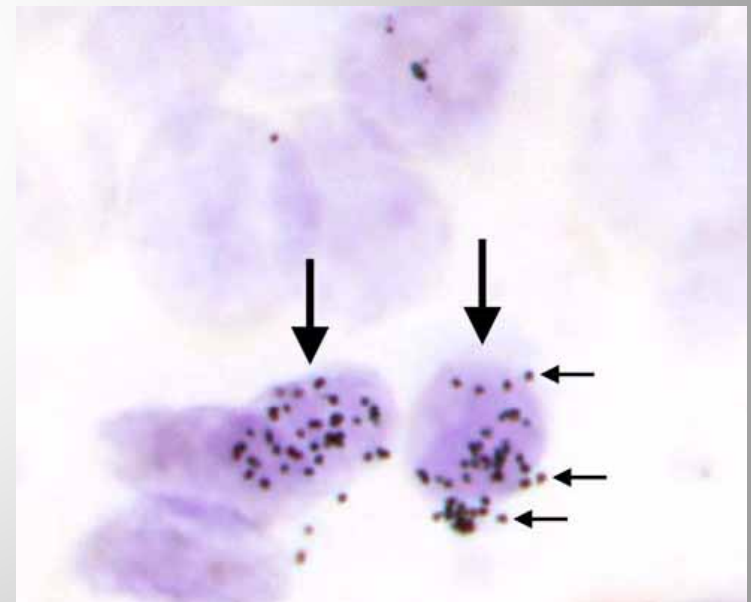
-NOT TRUE

Visualizing Neurogenesis



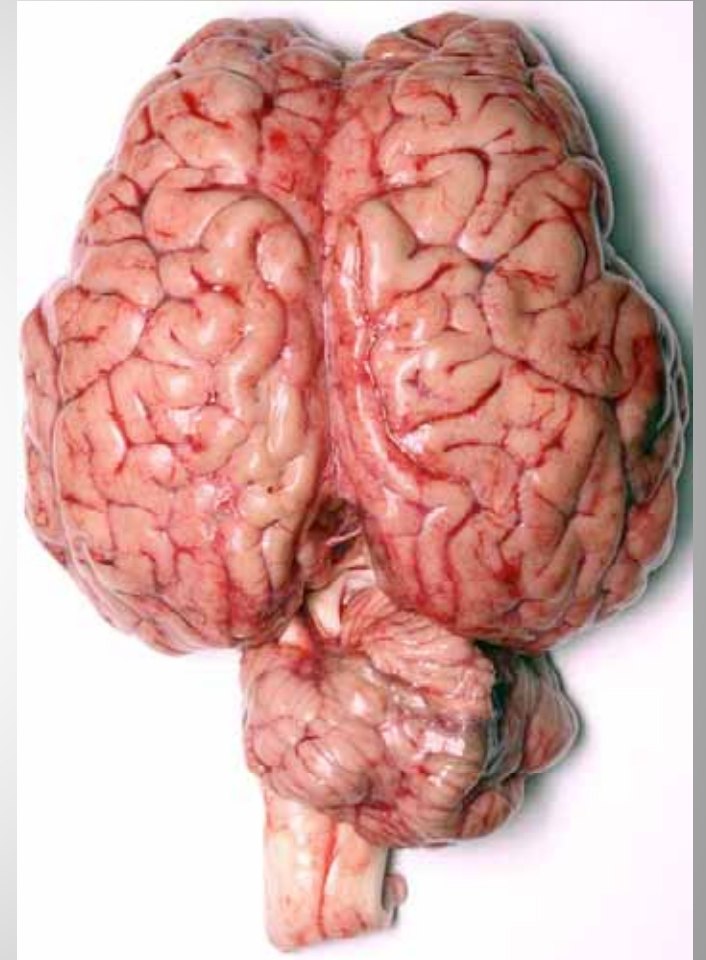
nucleotides (e.g. thymidine) get incorporated into DNA strands during replication

[³H] Thymidine and BrDu incorporate into dividing cells!



http://www.bcscience.com/bc9/pgs/quiz_section5.1.htm

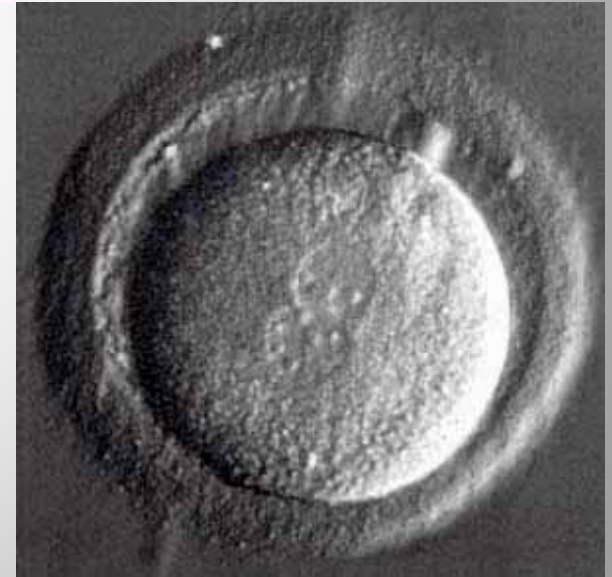
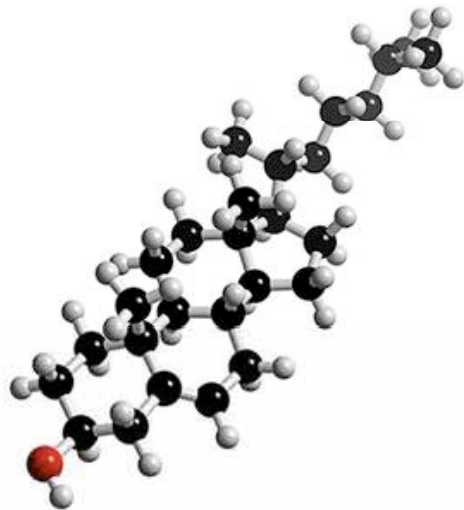
What does studying a songbird tell us about our brains



<http://i.livescience.com/images/080418-human-brain-02.jpg>

<http://http://www.faqs.org/photo-dict/photofiles/list/368/728canary.jpg>

Songbird Brain and Neurogenesis



<http://i.livescience.com/images/080418-human-brain-02.jpg>

<http://http://www.faqs.org/photo-dict/photofiles/list/368/728canary.jpg>

What is a songbird?

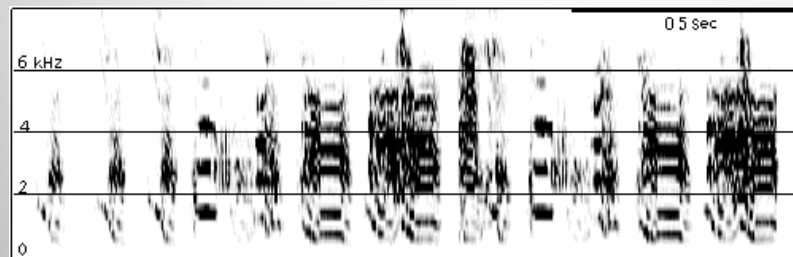


<http://www.americansingercanary.com/asc.htm>

Art Arnold, UCLA

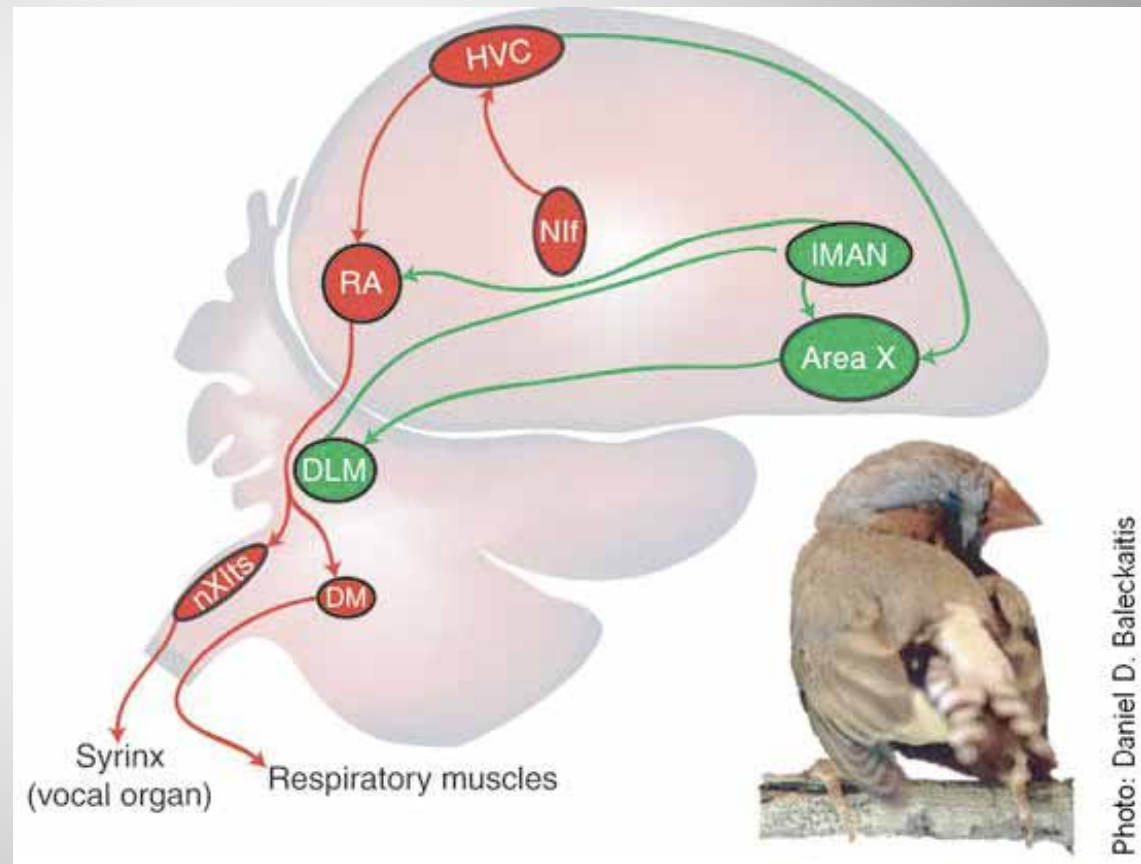
What is a songbird?

As a songbird, males use songs and calls to attract and bond with a mate



A Typical ZF Courtship Song

Songbird Brain and Singing



Margoliash, 2005

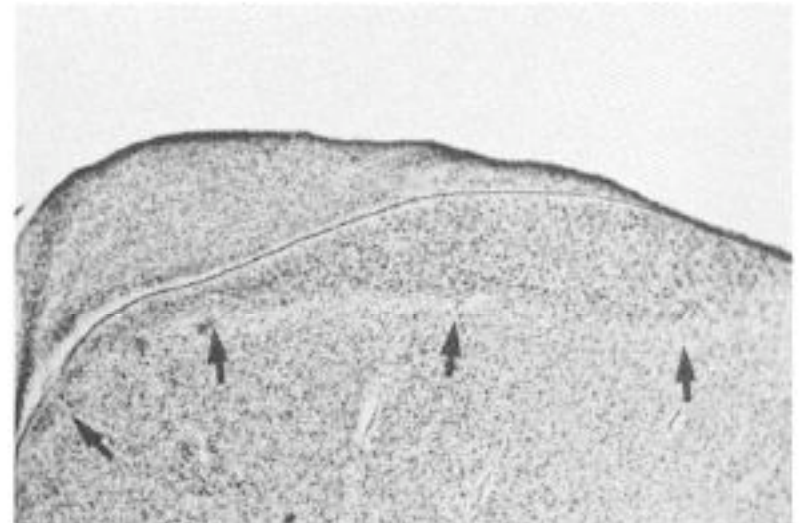
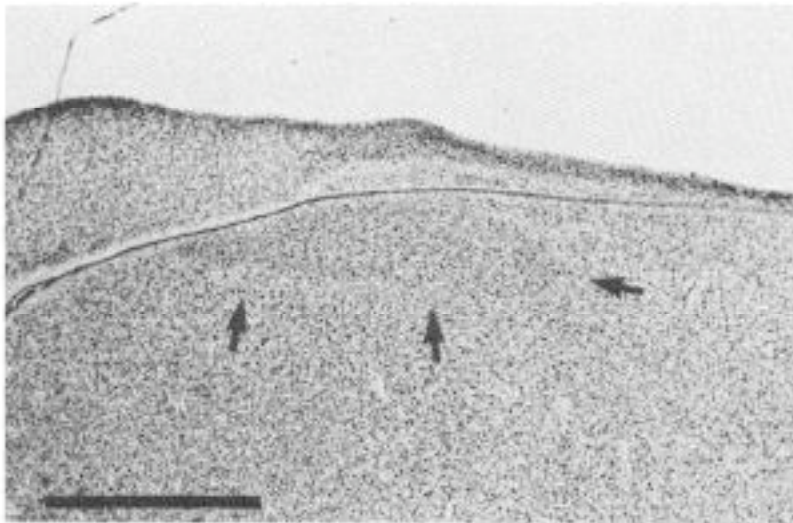
<http://http://www.faqs.org/photo-dict/photofiles/list/368/728canary.jpg>

Songbird Brain and Singing



Some songbird brains change dramatically across seasons

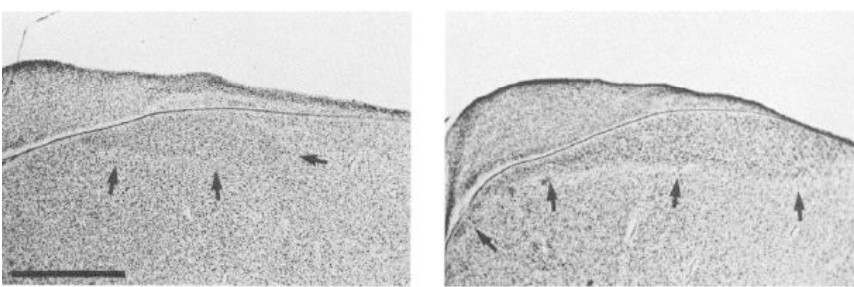
Brenowitz et al, 1991



<http://www.faqs.org/photo-dict/photofiles/list/368/728canary.jpg>

Songbird Brain and Singing

Some songbird brains change dramatically across seasons



Nottebohm, 1981

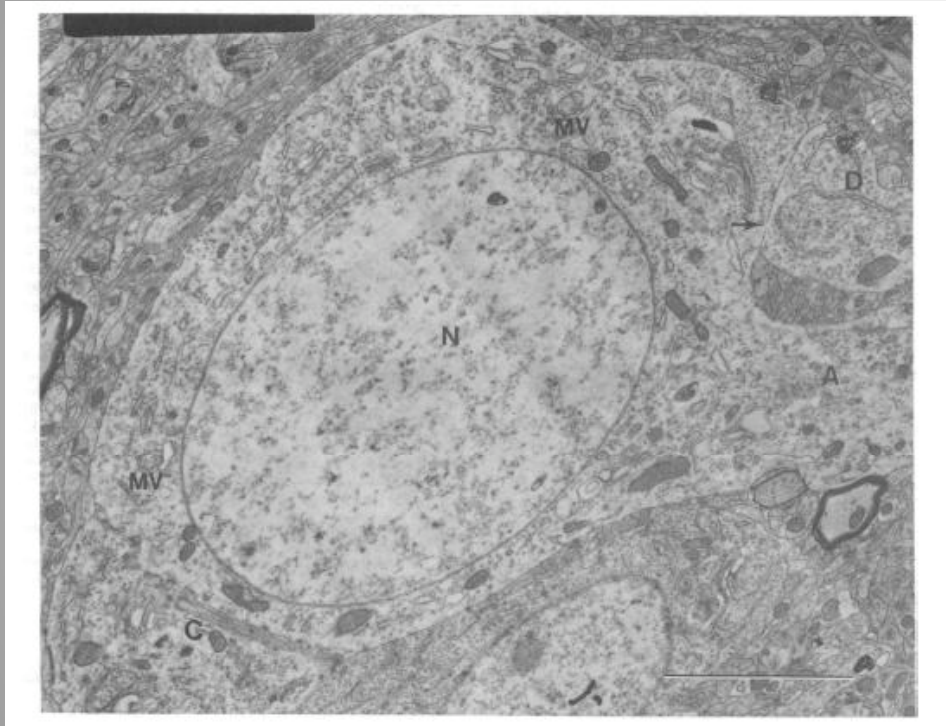
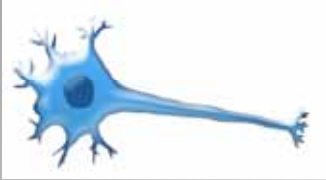
Table 1. Ratio of spring to fall measures of brain variables.

Variable	Mean \pm standard deviation		<i>P</i>	Spring: fall ratio
	Spring	Fall		
HVc* (mm ³)	0.884 \pm 0.243	0.444 \pm 0.105	< .001	1.99
RA* (mm ³)	0.519 \pm 0.114	0.293 \pm 0.058	< .001	1.77
Rt† (mm ³)	0.572 \pm 0.056	0.481 \pm 0.039	< .001	1.19
SpMt† (mm ³)	0.111 \pm 0.015	0.099 \pm 0.013	> .05	1.12
Caudal forebrain* (mm ³)	7.93 \pm 0.120	6.47 \pm 0.440	< .001	1.23
Brain weight (g)	0.754 \pm 0.065	0.655 \pm 0.041	< .001	1.15
HVc:Rt	0.764 \pm 0.186	0.463 \pm 0.118	< .001	1.65
RA:Rt	0.608 \pm 0.213	0.385 \pm 0.122	< .001	1.58

*Corresponds to volume reconstruction of left and right structures.

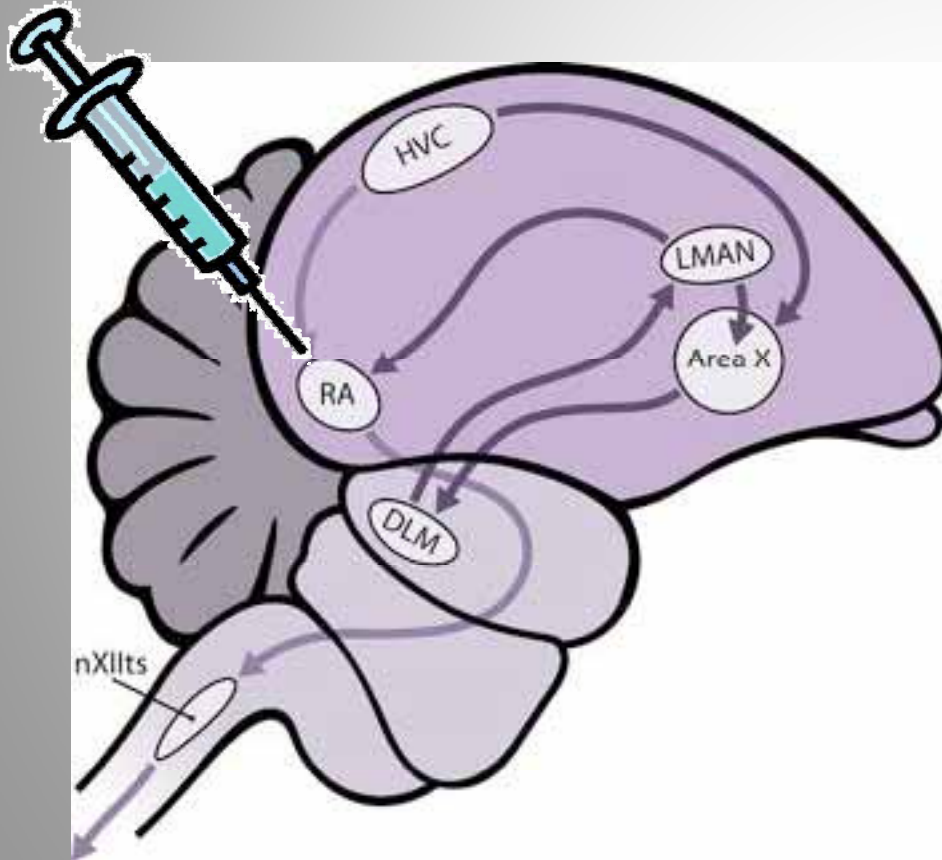
†Corresponds to volume reconstruction of left structures.

But is this change related to Neurogenesis?

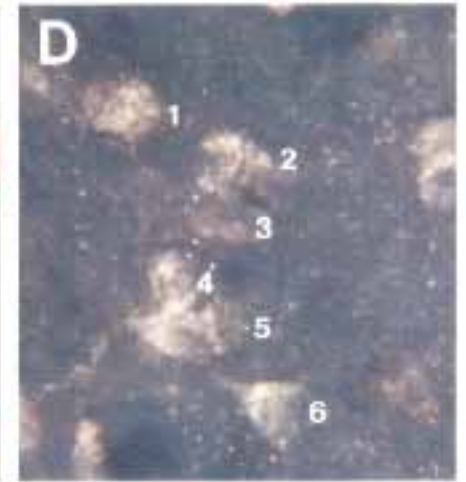
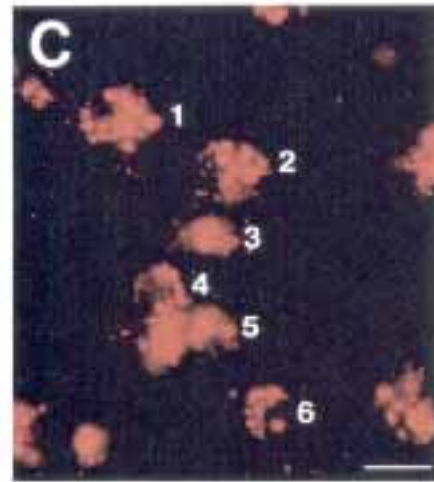


Electron micrograph of a new neuron in HVC. N = nucleus, A = axonal hillock, D = dendrite,

But is this change related to Neurogenesis?

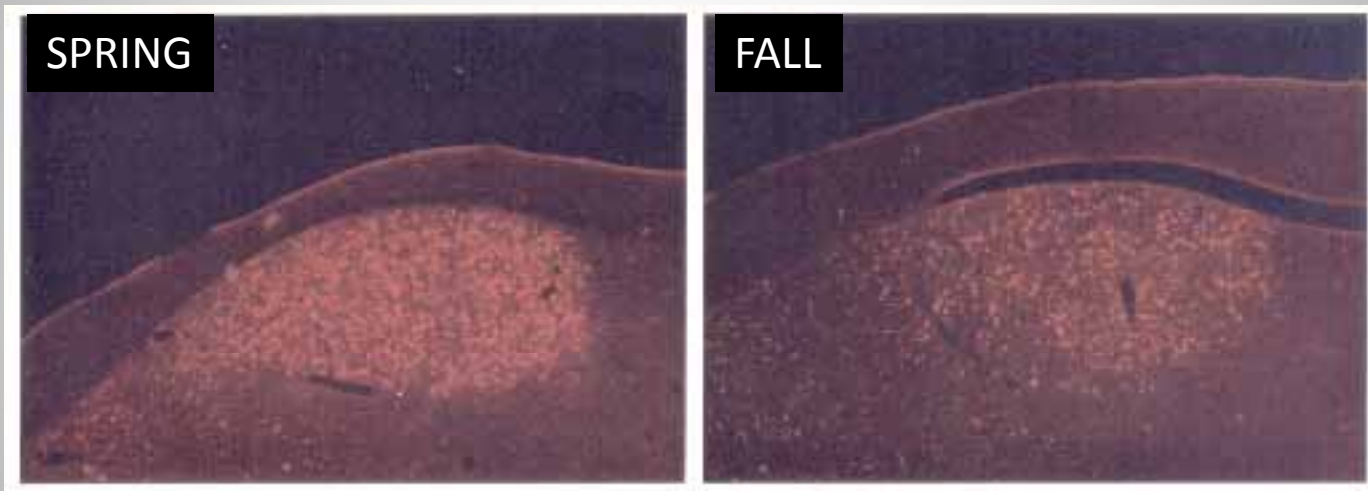


The retrograde tracer, Fluorogold was injected into RA, a nucleus known to be innervated by axons projecting from HVC



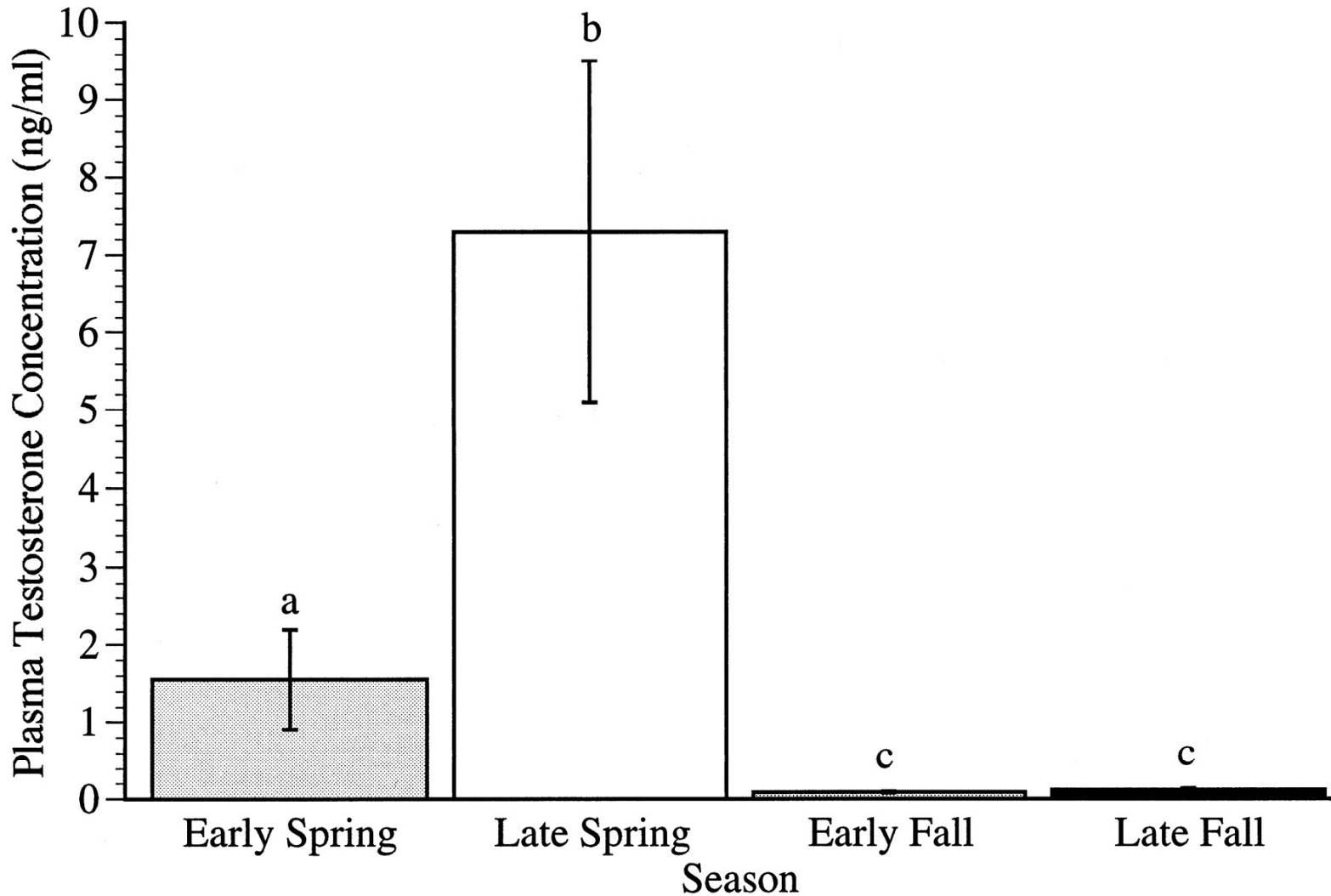
Kirn and Nottebohm, 1993

Is this seasonal change related to Steroids?



Kirn and Nottebohm, 1993

Is this seasonal change related to Steroids?



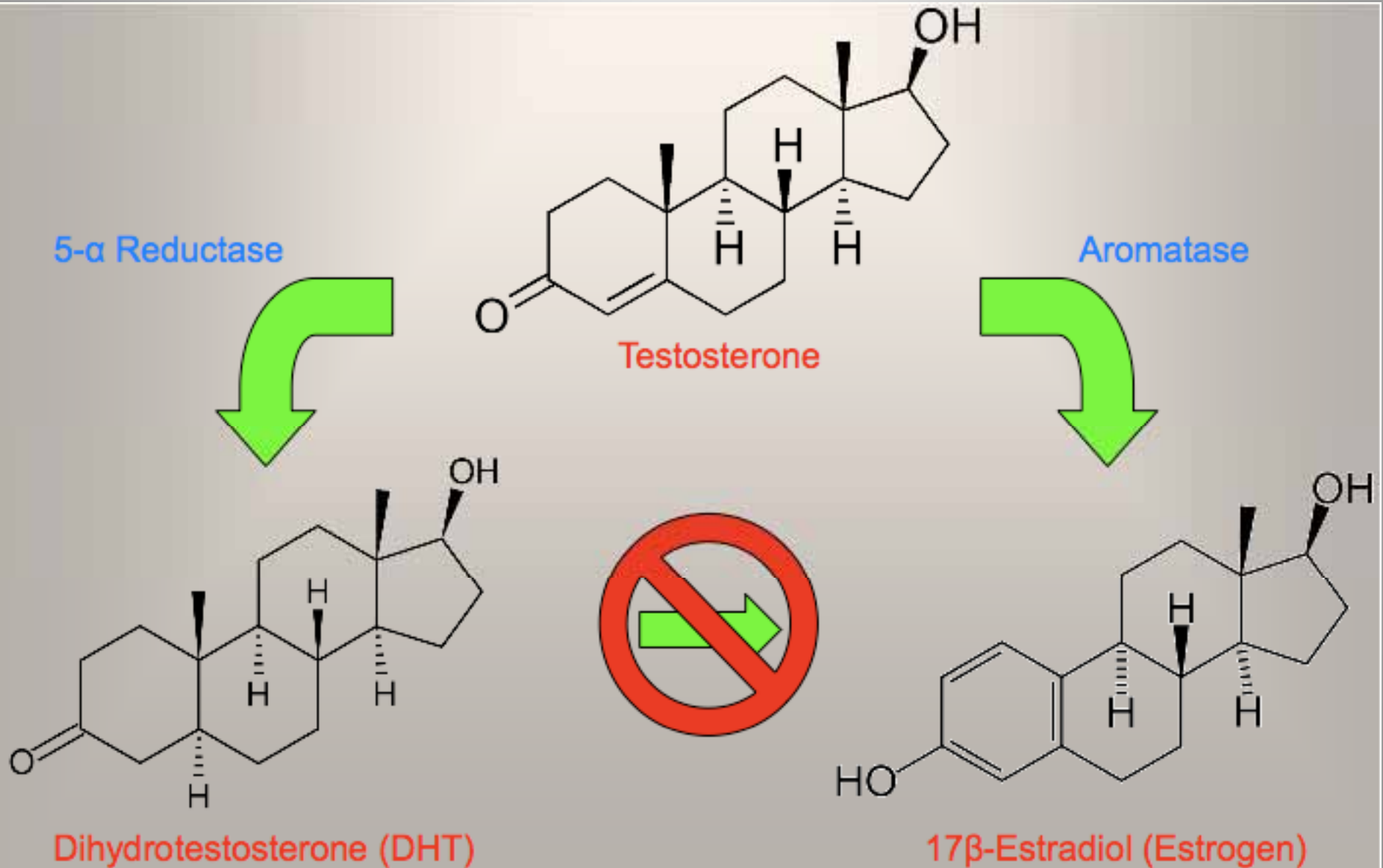
Testosterone increases neurogenesis?



TABLE 1
Means \pm Standard Deviations for Each Experimental Condition

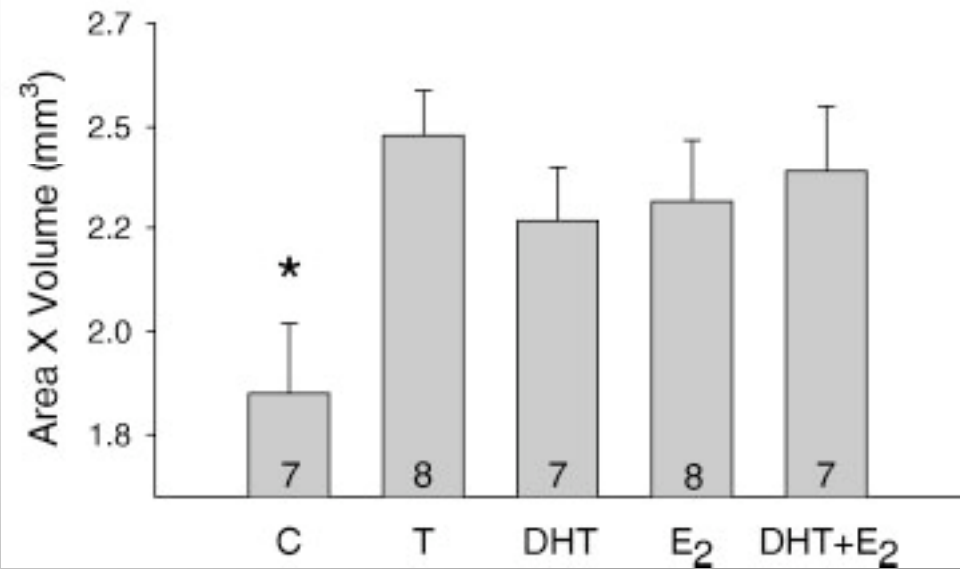
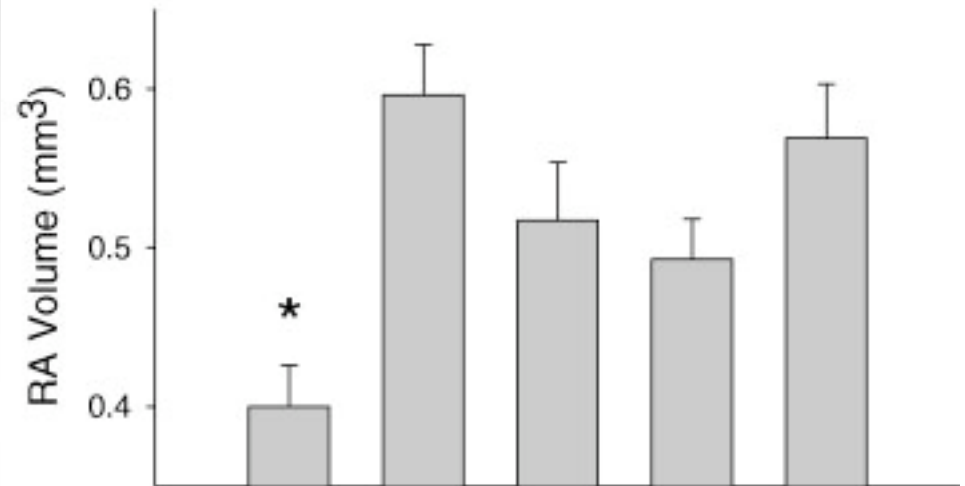
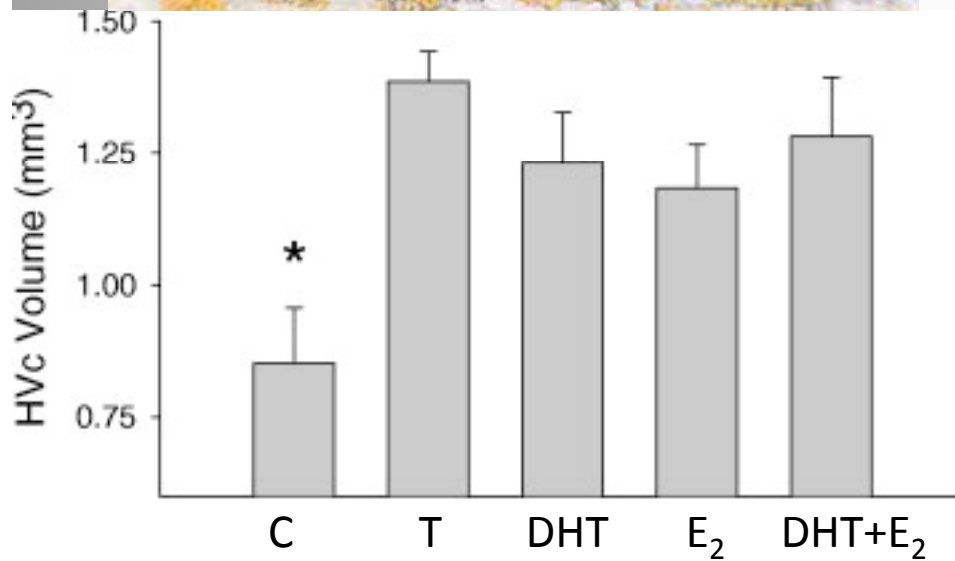
	Volume (mm ³)	Neuron Density (per mm ³)	Neuron Number	Somal Area (μ m ²)
RA				
T-Sham	0.236 \pm 0.034	76,546 \pm 14,912	17,913 \pm 3,500	118.9 \pm 26.5
\emptyset -Sham	0.139 \pm 0.021	106,104 \pm 18,567	14,561 \pm 1,766	96.0 \pm 15.5
HVe				
T-Sham	0.659 \pm 0.133	215,667 \pm 22,210	141,055 \pm 24,351	66.7 \pm 8.8
\emptyset -Sham	0.291 \pm 0.096	290,714 \pm 58,058	83,404 \pm 28,331	54.2 \pm 8.5

However, Testosterone can be metabolized in the brain...

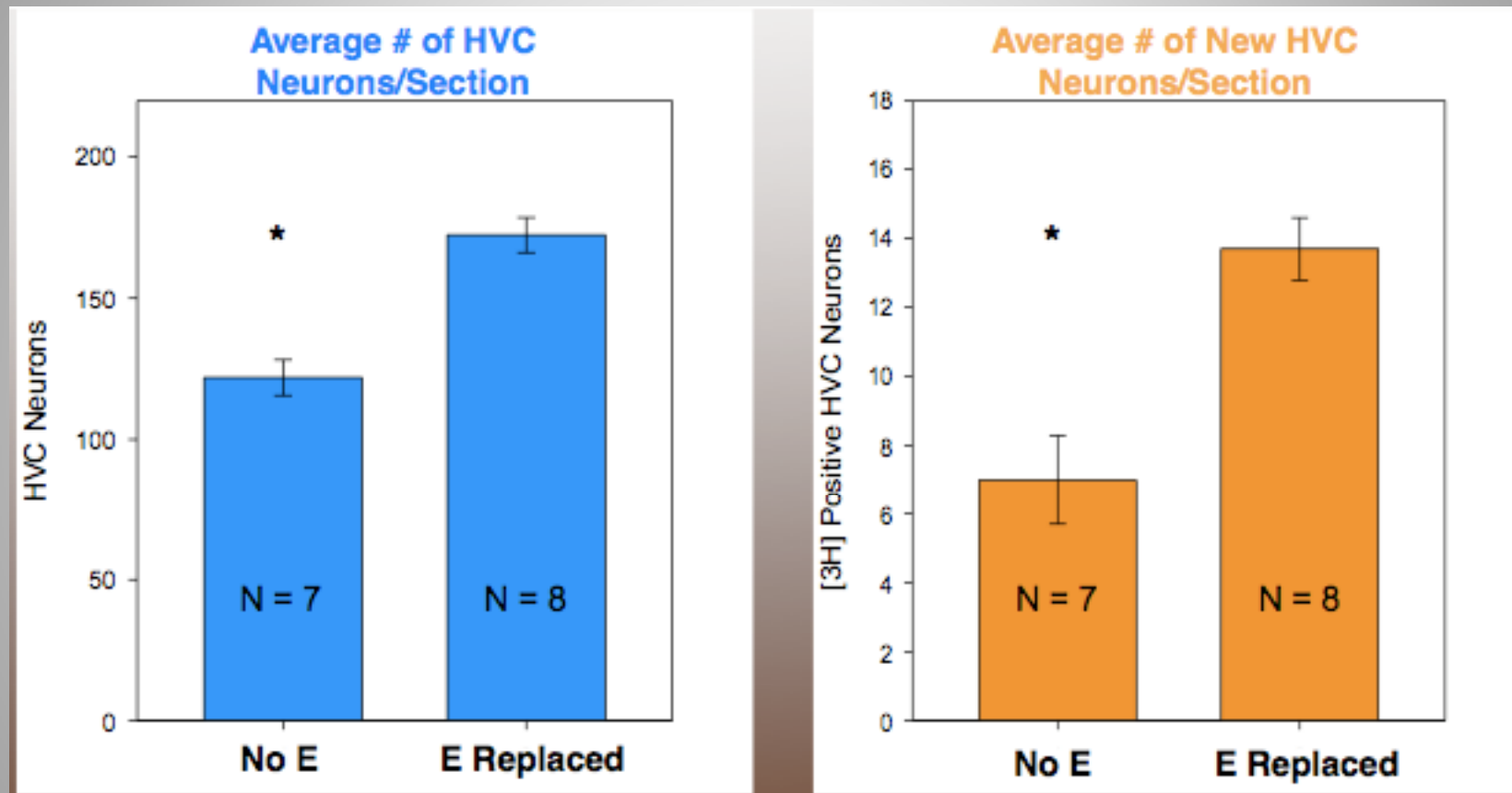


So which steroid is it?

Tramontin et al. 2003

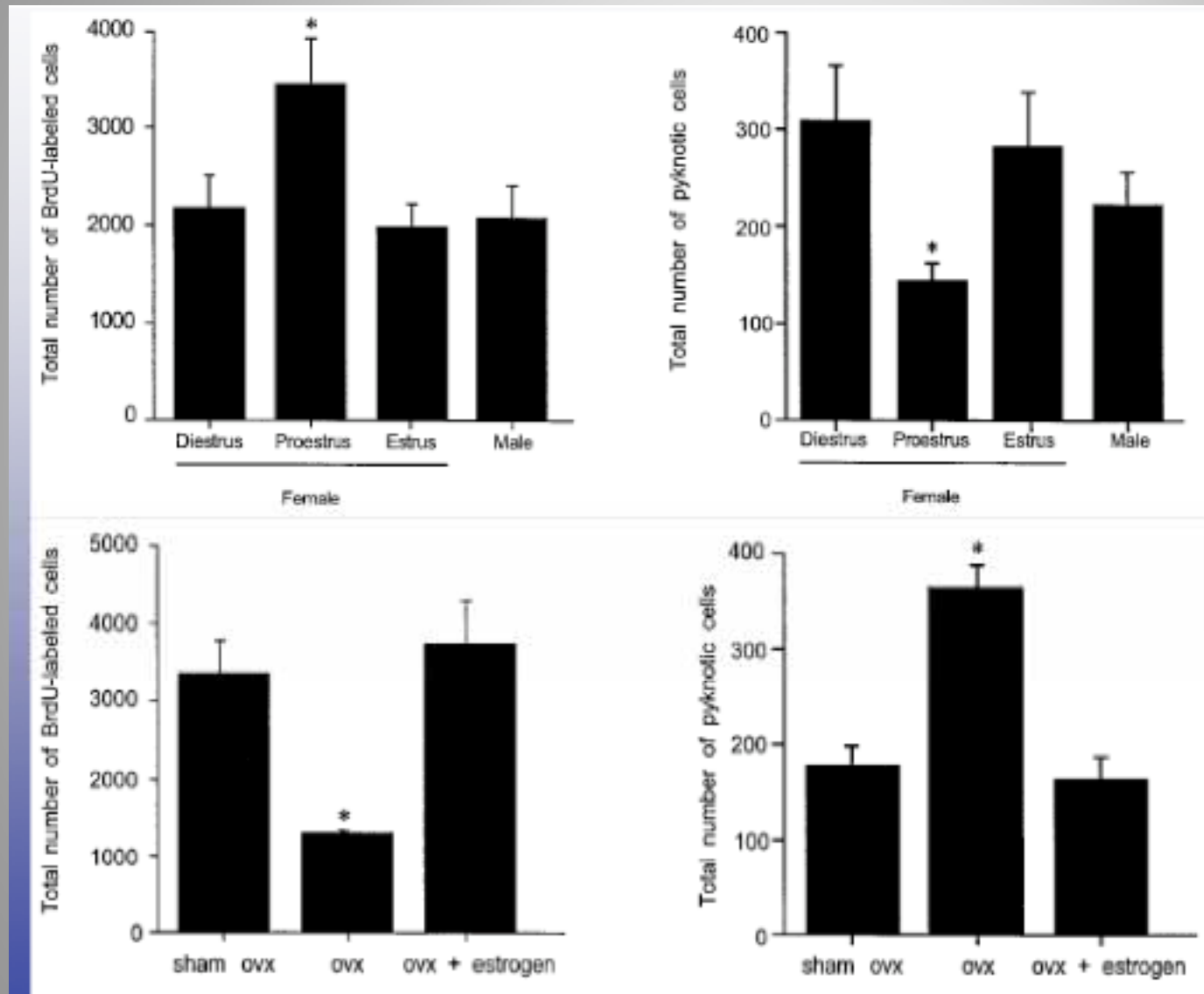


So which steroid is it?



adapted from *Hidalgo et al. 1995*

Estrogens enhance mammalian neurogenesis



Tanapat et al. 1999





Photograph by Bates Littlehales available at <http://animals.nationalgeographic.com/animals/printable/pileated-woodpecker.html>