

Practice exam questions have been posted next to the exam date

No office hours this Friday, please make appointment if you want to meet

Please read Chapter 20 (Cloning) and page 334

The book is very “thin” on stem cells, so you might want to take some notes

I'll have access to the MCB41 website soon, so the PPTs and abstracts will be posted
ASAP

Today: Part 1 mouse ES cells

Human ES will be next, after the midterm

Stem Cells

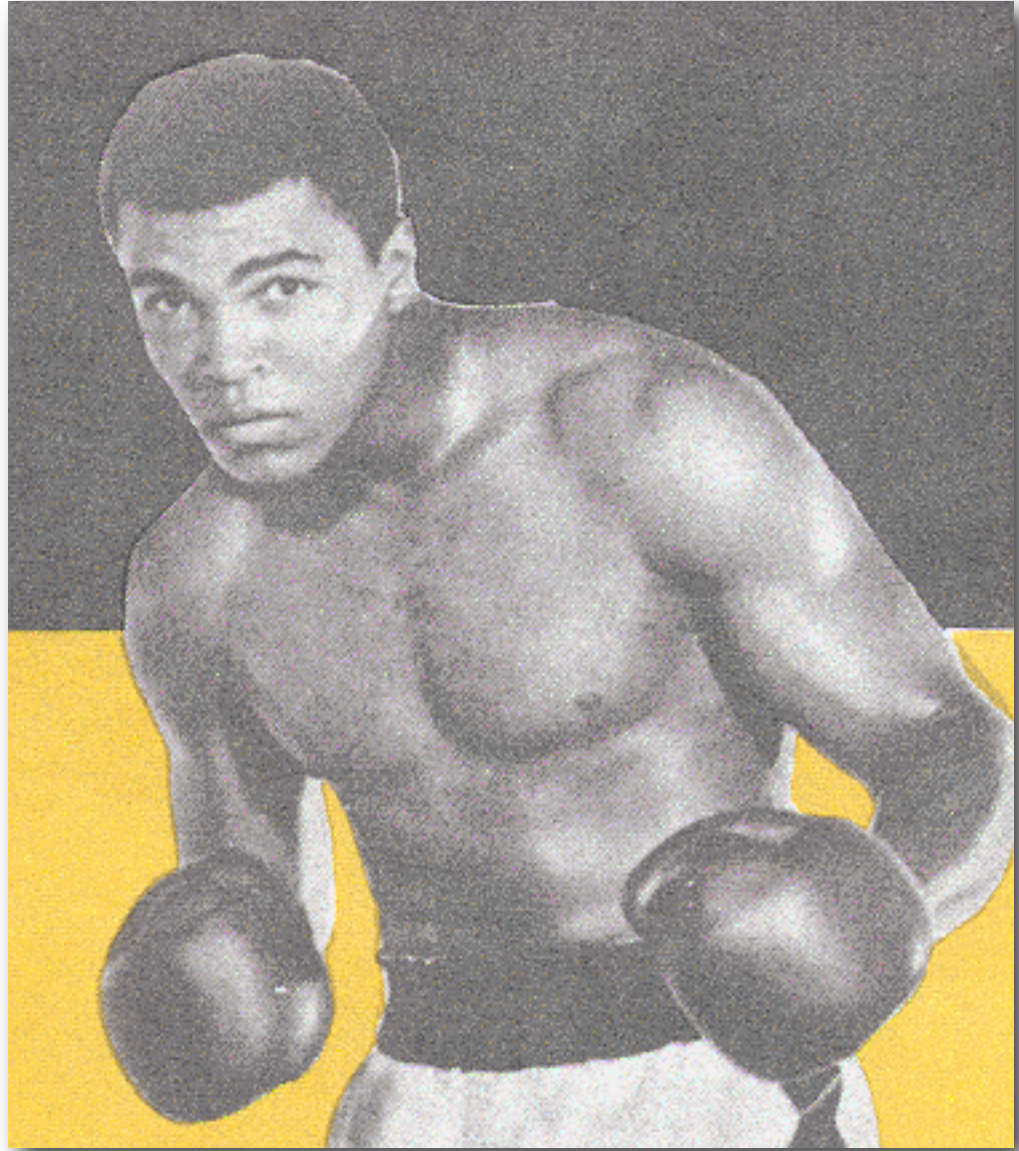
Self-renewal - the ability to go through numerous cycles of cell division while maintaining the undifferentiated state.

Potency - the capacity to differentiate into specialized cell types.

- Totipotent To be able to give rise to all cell types
- Pluripotent to be able to give rise to any mature cell type
- Multipotent to be able to give rise to multiple mature cell types
- Oligopotent to be able to give rise to a few mature cell types
- Unipotent to be able to give rise to one cell type

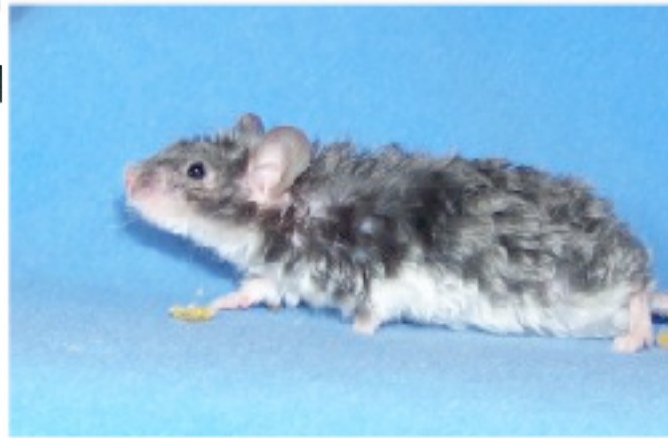
Mouse vs Human

Mouse vs Human



Mouse Fancy

Basis of the modern
lab strains

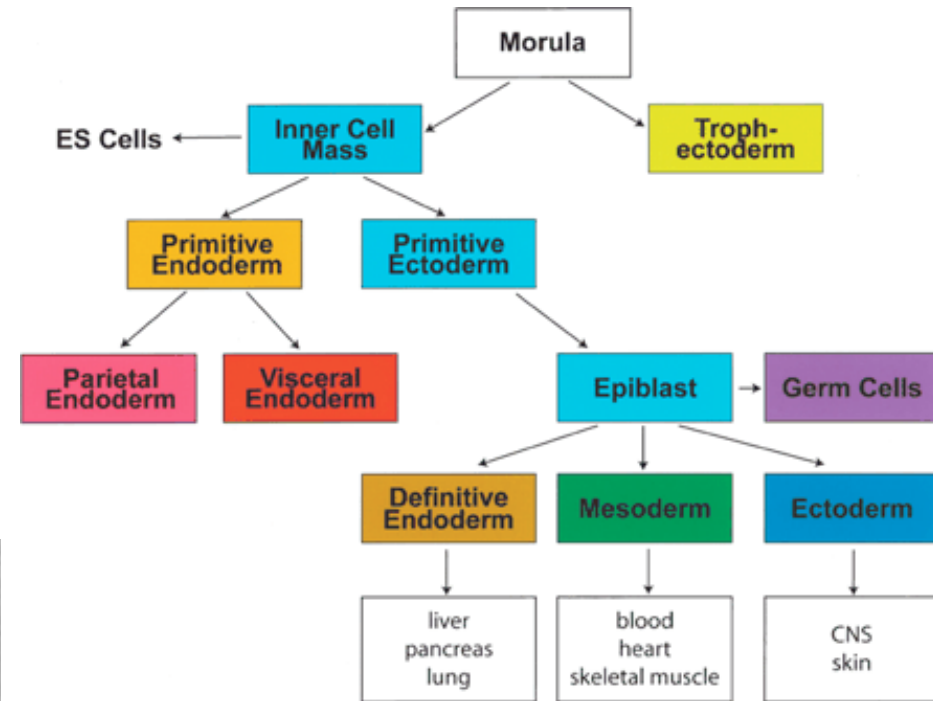




Mouse as a model system

- Genetics
- Genome that is similar to Human
- Several lines bred to homozygosity (no allelic variation)
- Susceptible to diseases such as cancer
- Short time to maturity (for a mammal anyway)
- Large litters
- Low “cuteness” factor
- Easy to keep

Early Development and the Pluripotent Inner Cell Mass



A blastocyst is a microscopic group of cells that is small enough to fit into Roosevelt's eye on the face of a U.S. dime.

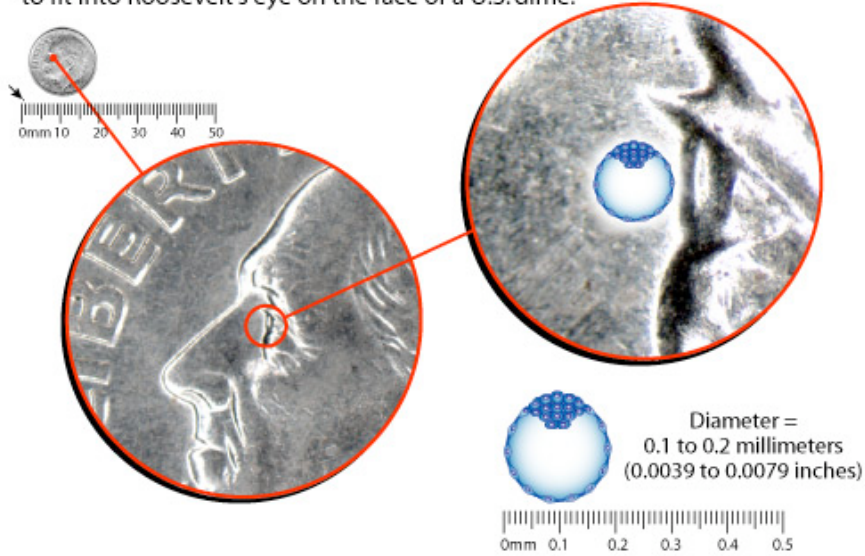
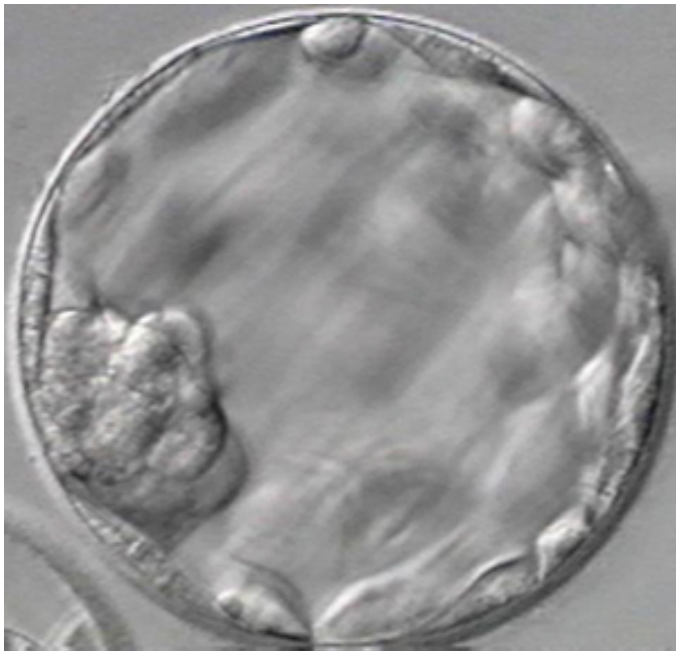


Illustration by [Cell Imaging Core](#) of the Center for Reproductive Sciences.



Blastocyst and inner cell mass

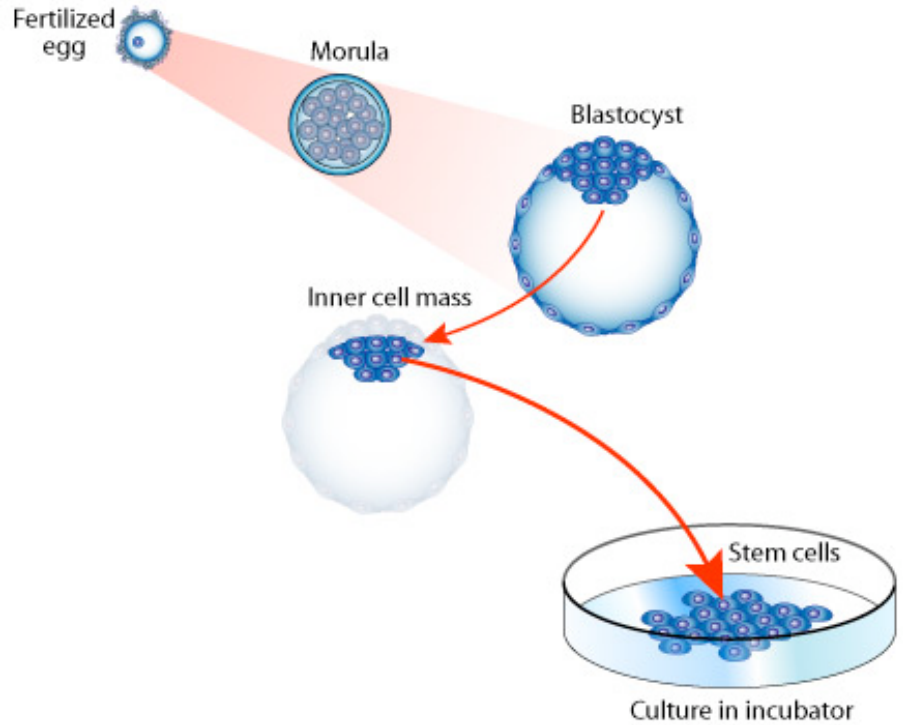
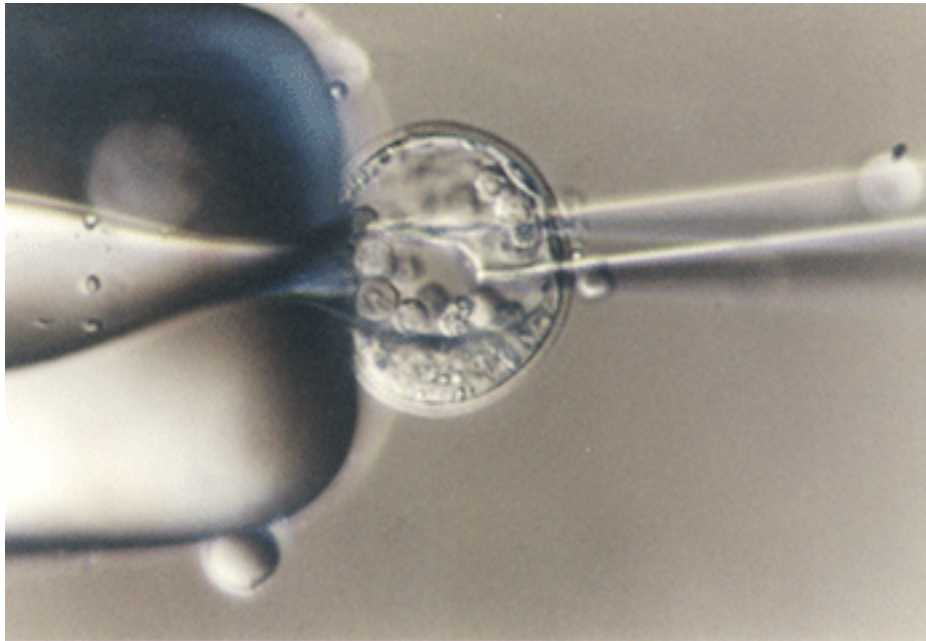
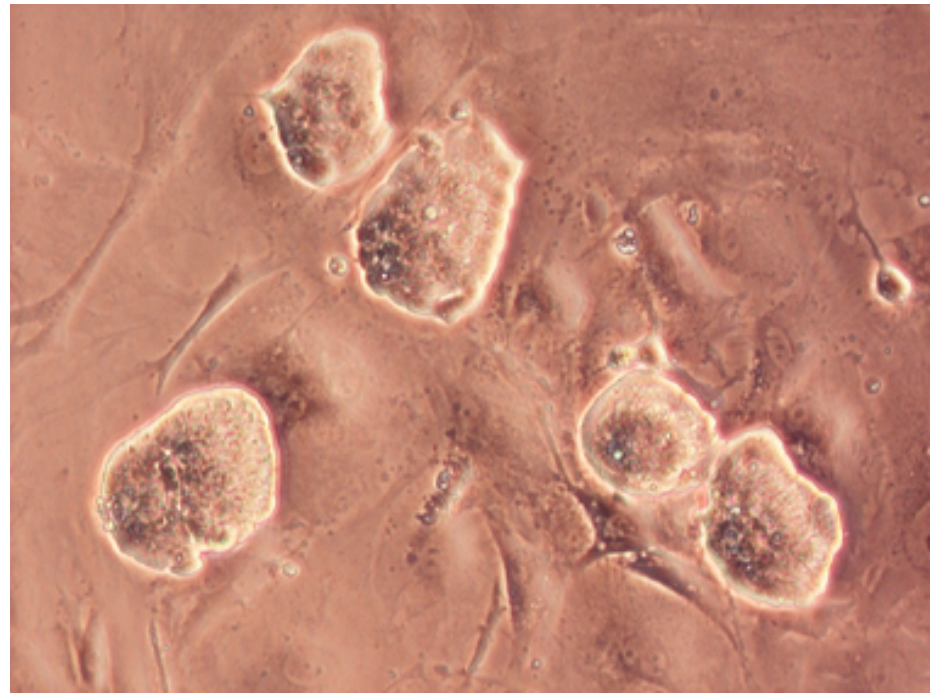


Illustration by [Cell Imaging Core](#) of the Center for Reproductive Sciences.

Mouse Embryonic Stem cells

- Pluripotent
- Can be genetically altered
- Differentiation in Vitro

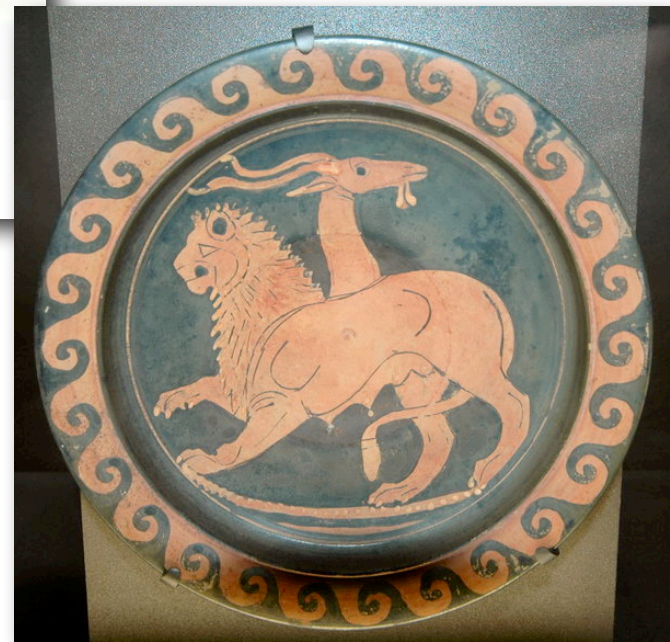


Proof of Pluripotency



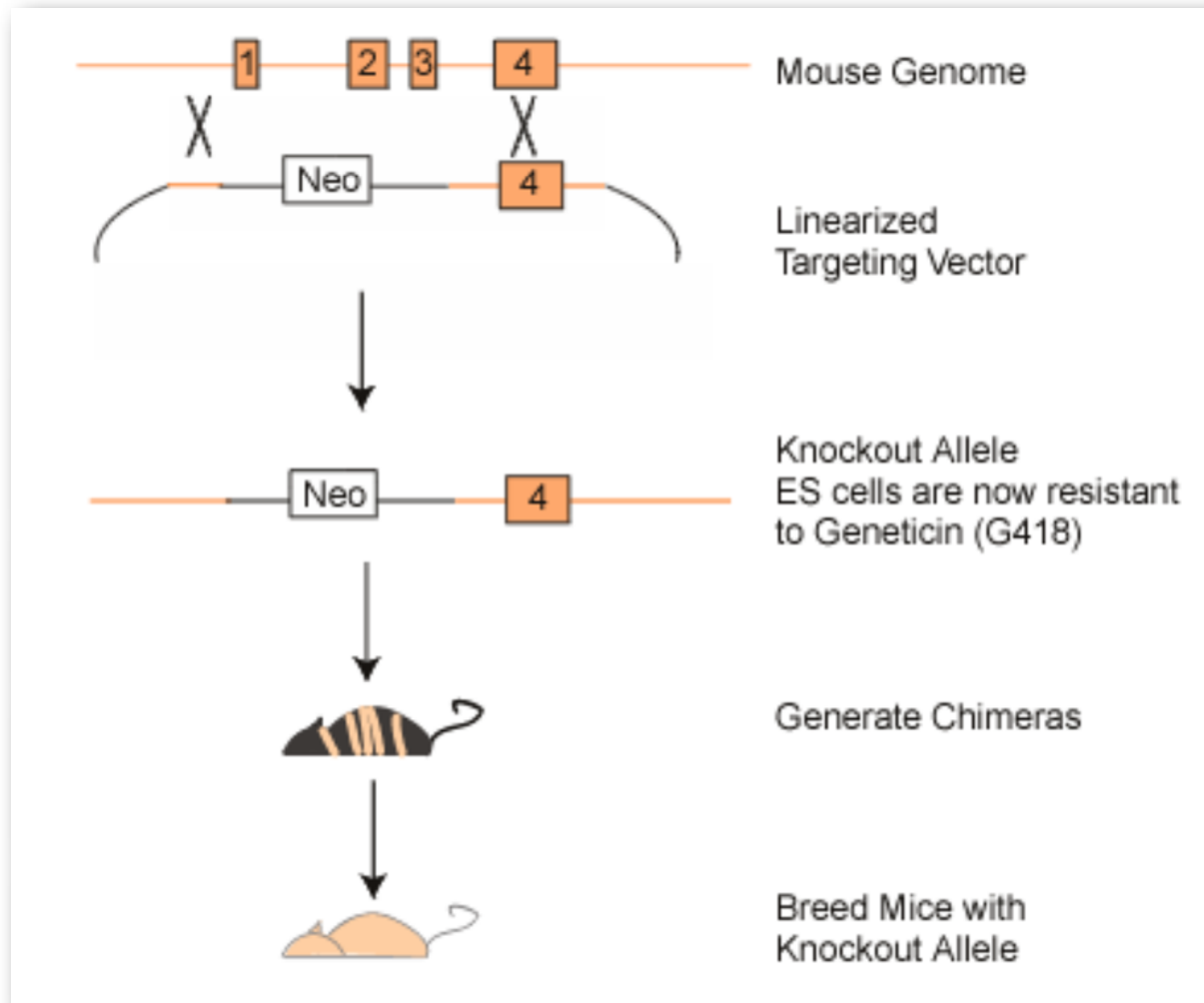
Chimeras

Homer's Chimera
Louvre, Paris



Genetic Alterations

Just take out/replace out any gene you want
(remember the bat genes in that mouse?)



VERY useful in studying monogenetic diseases

Cystic Fibrosis (CF) - The *Cftr* knockout mouse has helped advance research into cystic fibrosis, the most common fatal genetic disease in the United States today, occurring in approximately one of every 3,300 live births. Scientists now know that CF is caused by a small defect in the gene that manufactures CFTR, a protein that regulates the passage of salts and water in and out of cells.

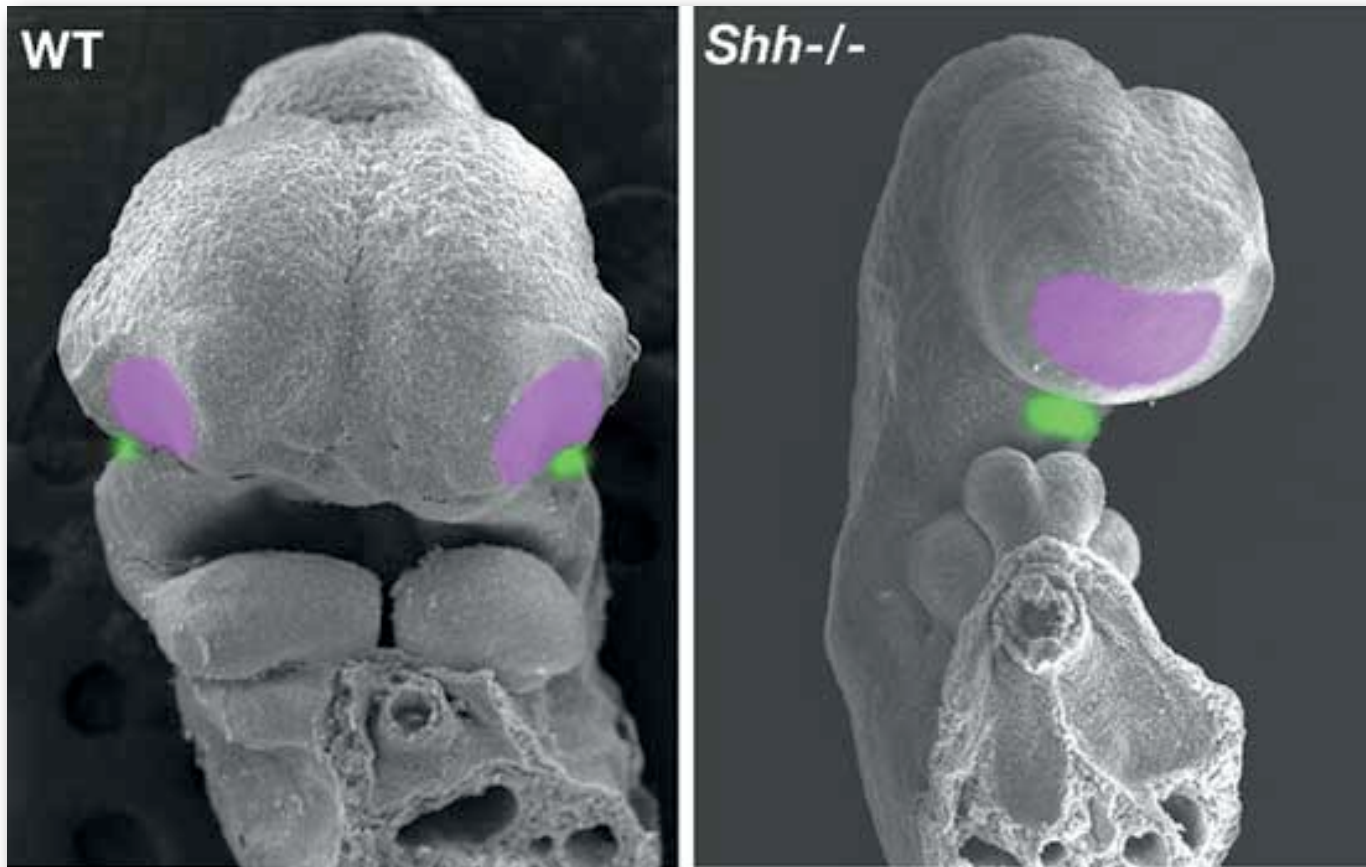
Cancer - The p53 knockout mouse has a disabled *Trp53* tumor suppressor gene that makes it highly susceptible to various cancers, including lymphomas and osteosarcomas.

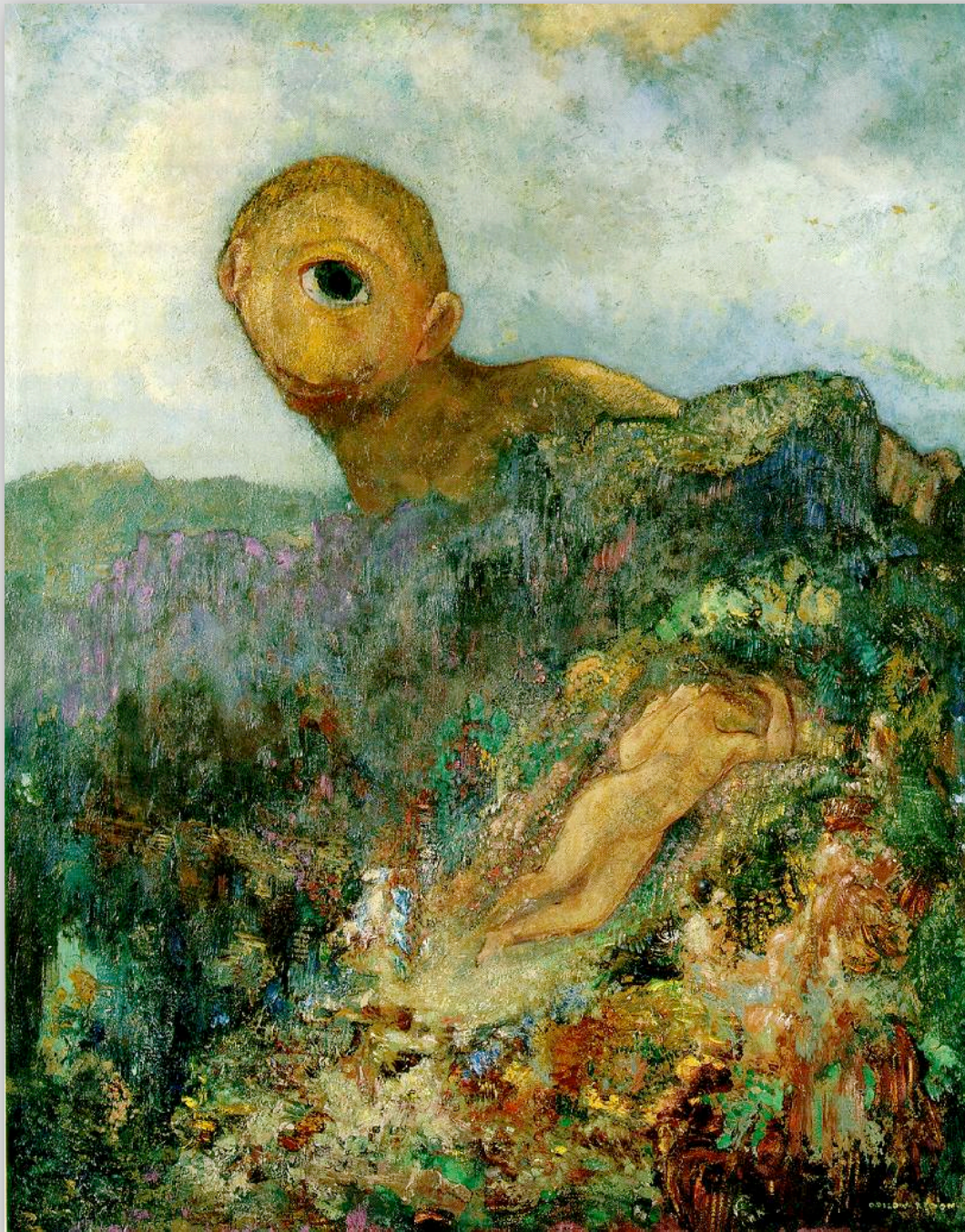
Muscular Dystrophy - The *Dmd*^{*mdx*} mouse is a model for Duchenne Muscular Dystrophy, a rare neuromuscular disorder in young males that is inherited as an X-linked recessive trait and results in progressive muscle degeneration.

Ovarian Tumors - The SWR and SWXJ mouse models provide excellent research platforms for studying the genetic basis of ovarian granulosa cell tumors, a common and very serious form of malignant ovarian tumor in young girls and post-menopausal women.

VERY Useful to study Development

<http://www.nih.gov/science/models/mouse/knockout/index.html>

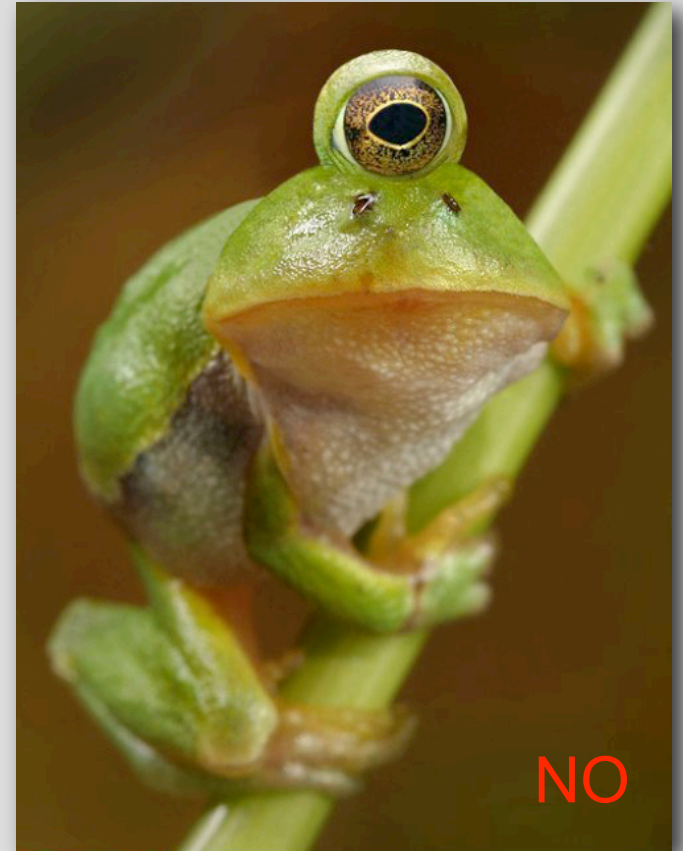
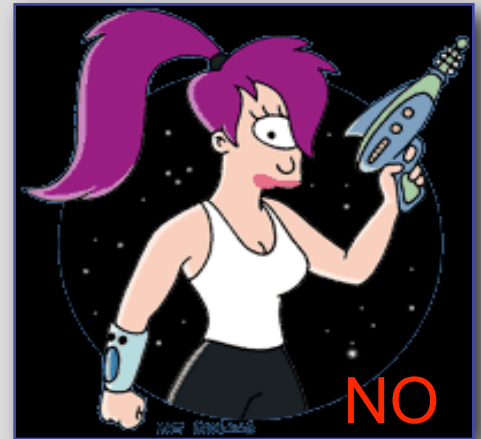




Polyphemus,
the most
famous cyclops

Cyclops
Odilon Redon
Rijksmuseum Kröller Müller

Are they real??

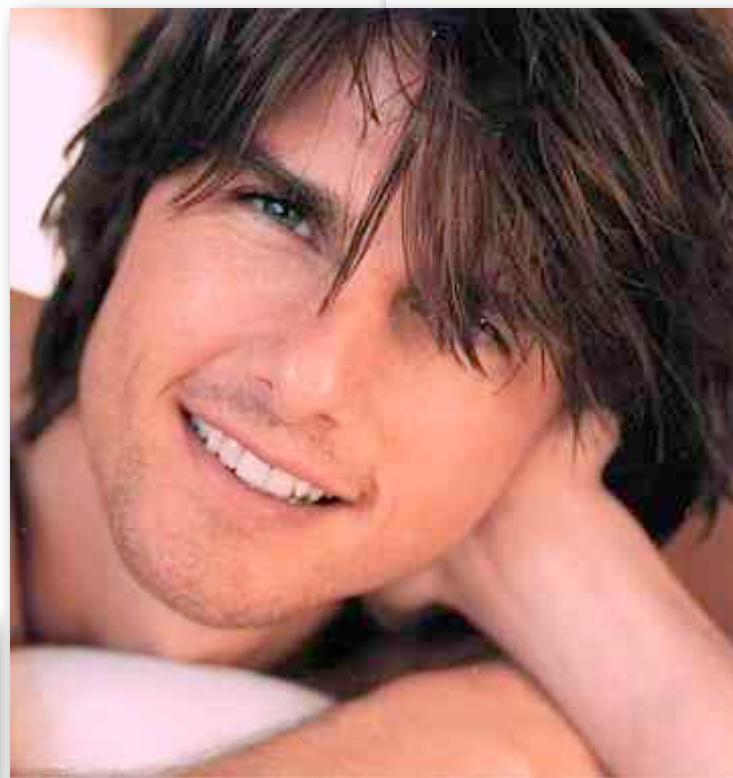




A

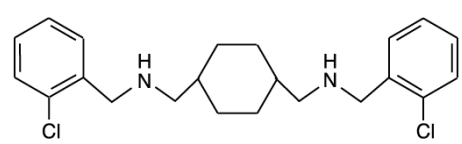
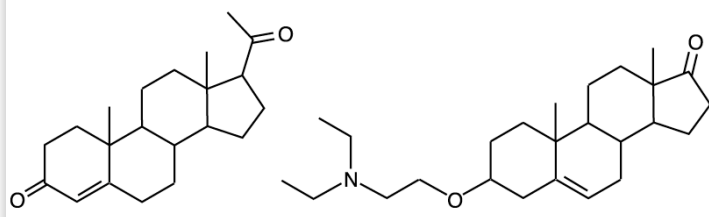
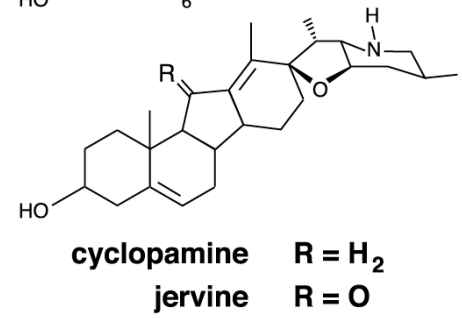
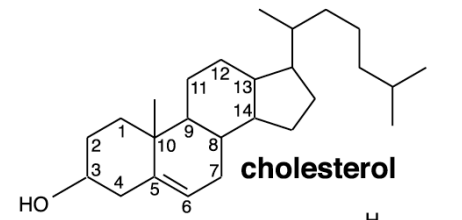
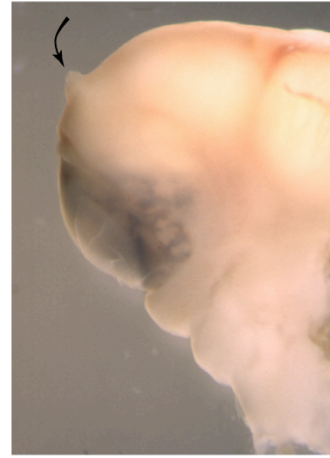
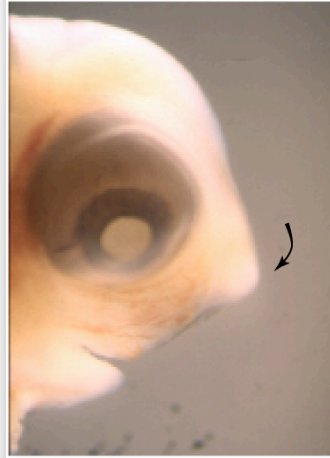
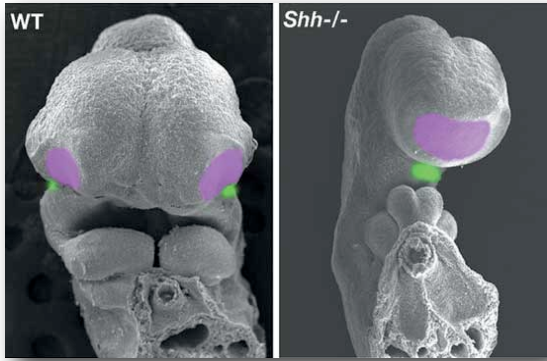
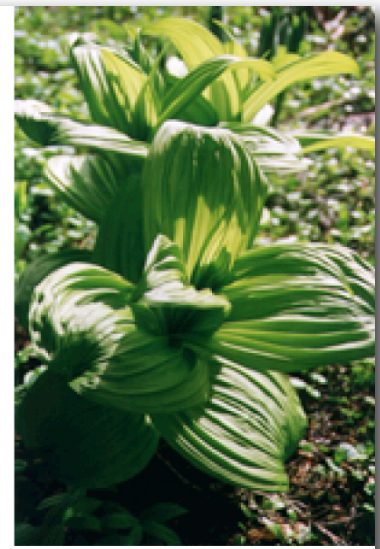


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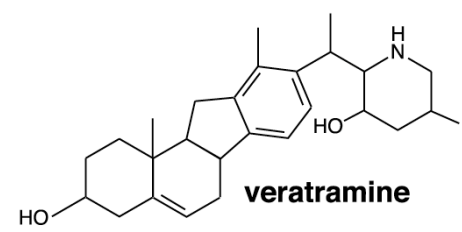


E

Plants and Cyclopia



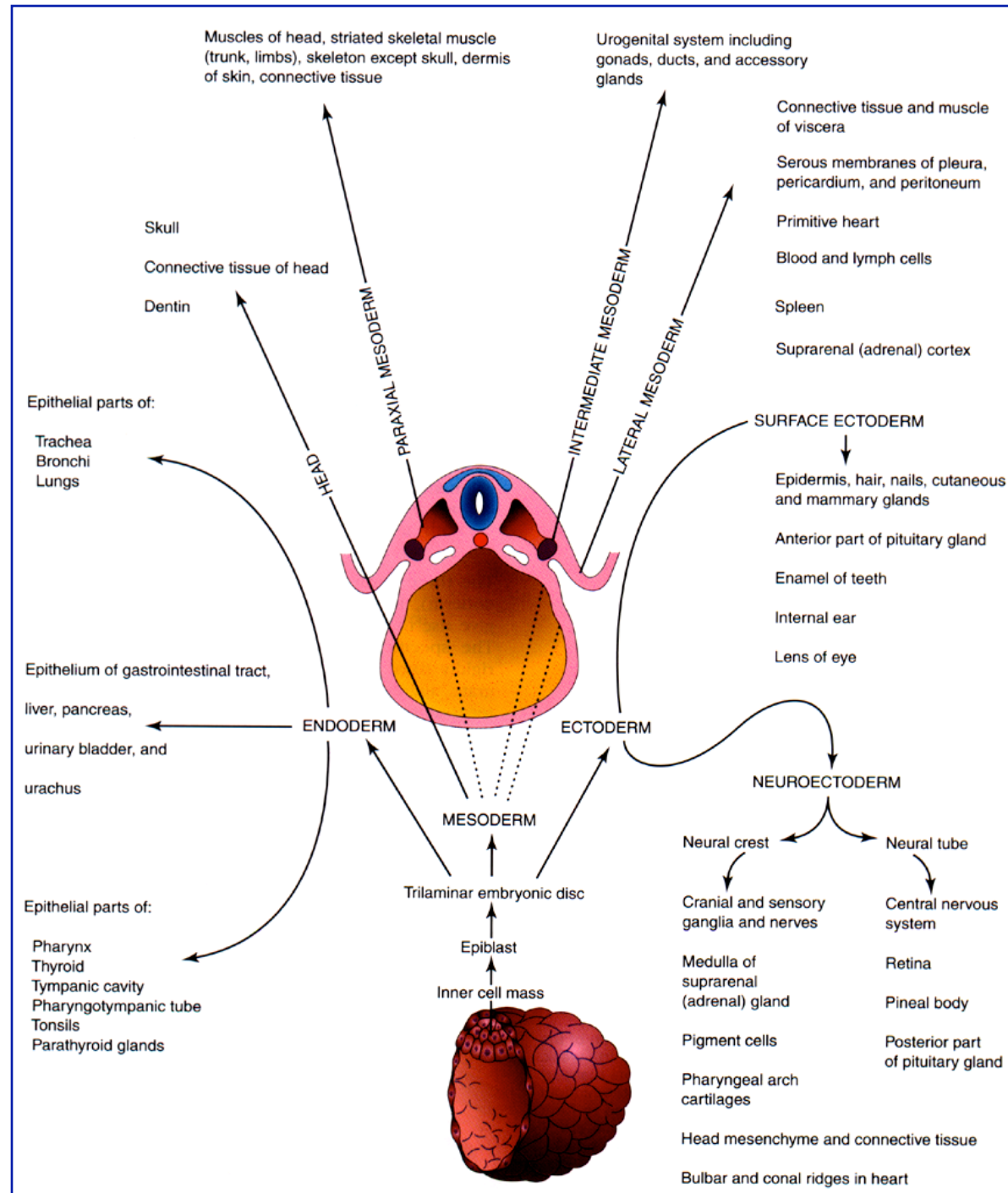
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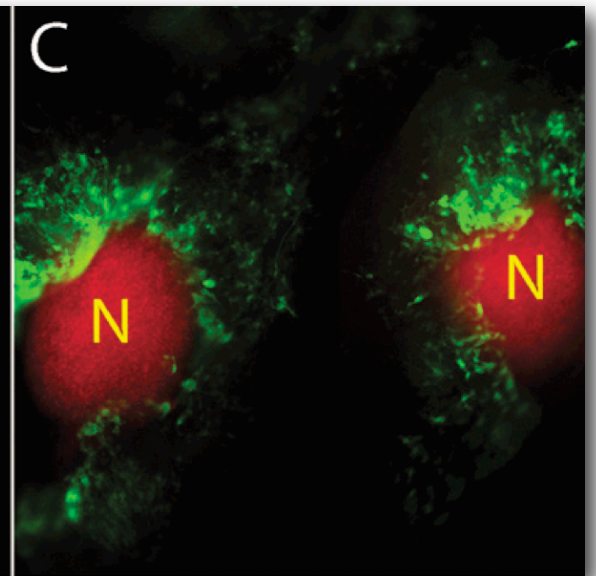
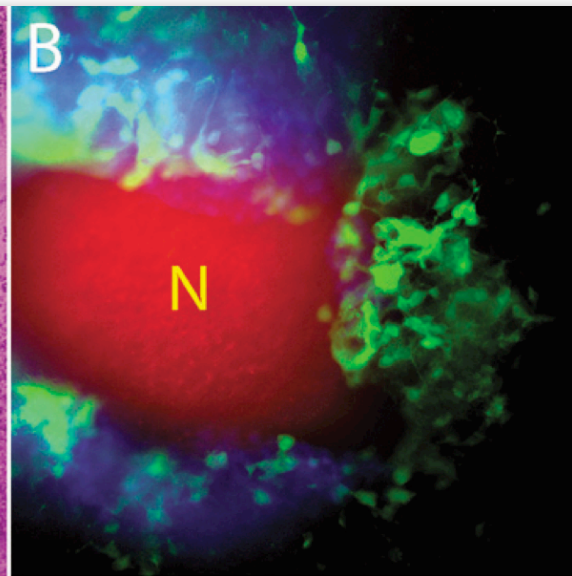
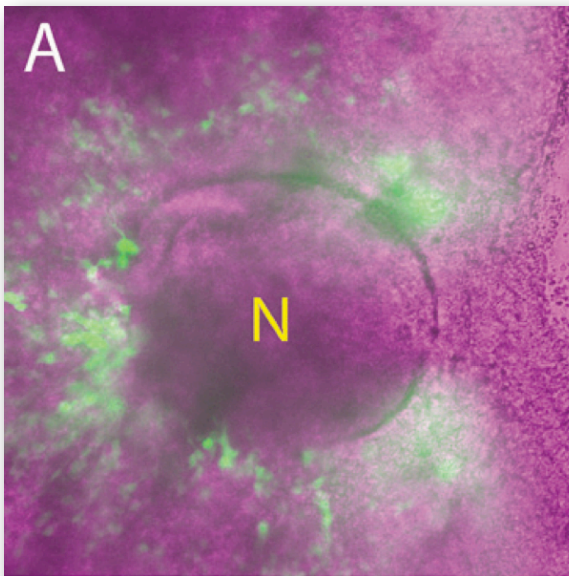
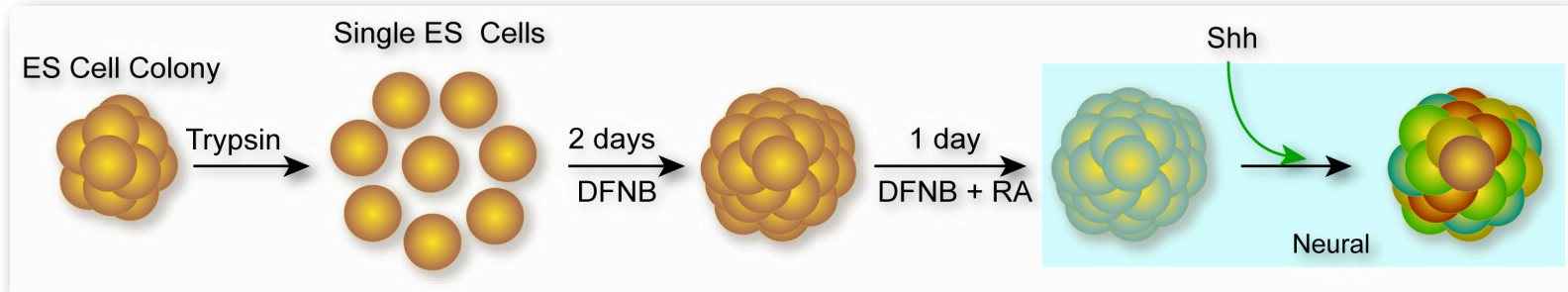
Mouse ES Cells:

- Do experiments you can never do in a human
- Make models for human diseases
- Study gene function in development
- Practice things you want to do with human ES cells

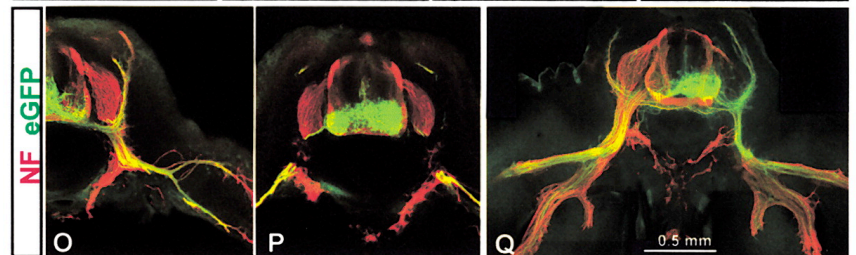
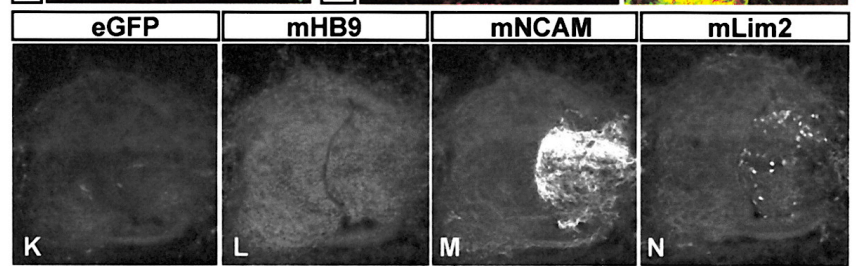
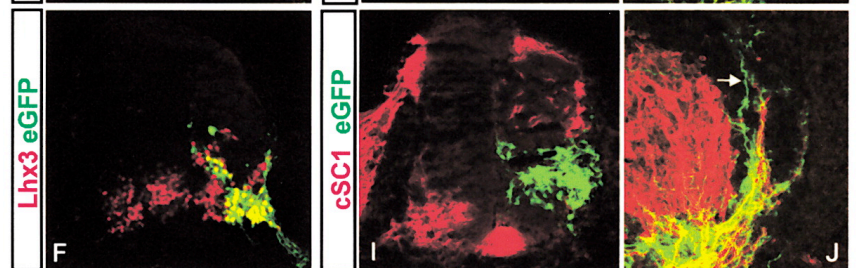
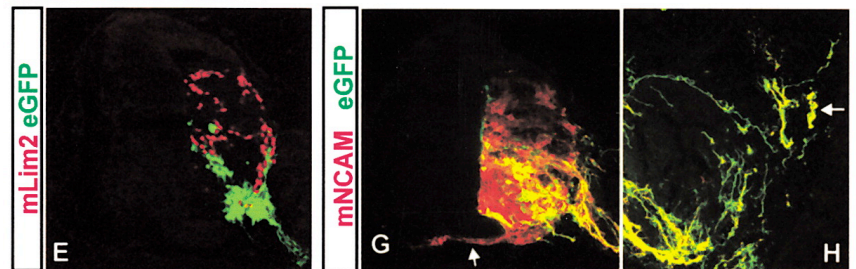
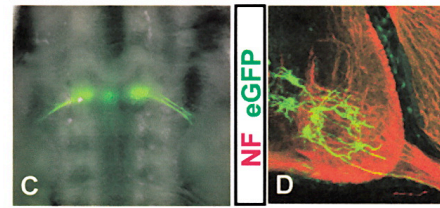
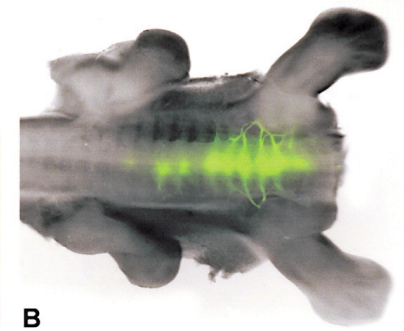
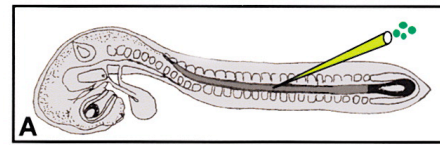
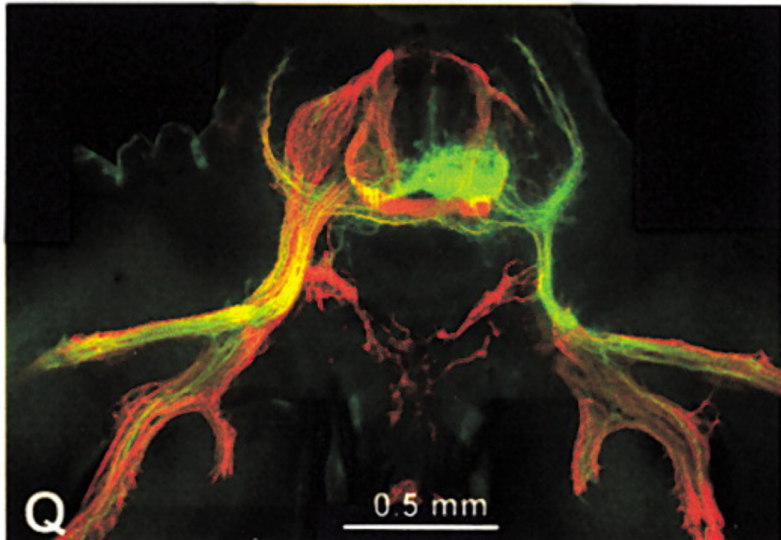
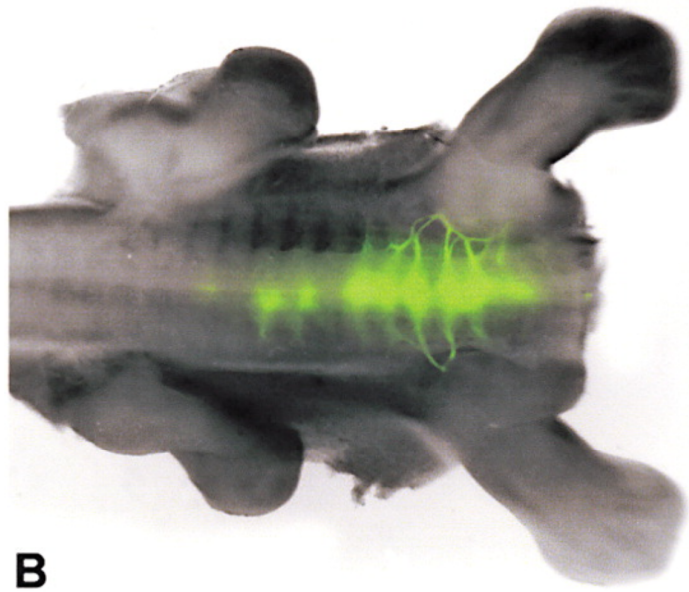
Mammalian Development: Birdeye's View



Making Neurons in a dish....



And put them in an embryo



Cell types made from mouse ES cells

Embryonic Germ Layer	Cell Type
Ectoderm (external layer)	neurons
	dopaminergic neurons
	motor neurons
	oligodendrocytes
	astrocytes
	epithelial cells
Mesoderm (middle layer)	adipocytes
	cardiomyocytes
	chondrocytes
	hematopoietic cells
	hematopoietic stem cells
	dendritic cells
	mast cells
	B cells
	natural killer cells
	lymphoid precursors
	endothelial cells
	osteoblasts
	striated muscle cells
	smooth muscle cells
	macrophages
Endoderm (internal layer)	pancreatic-like islets
	insulin-producing cells
	alveolar epithelium
	hepatocytes