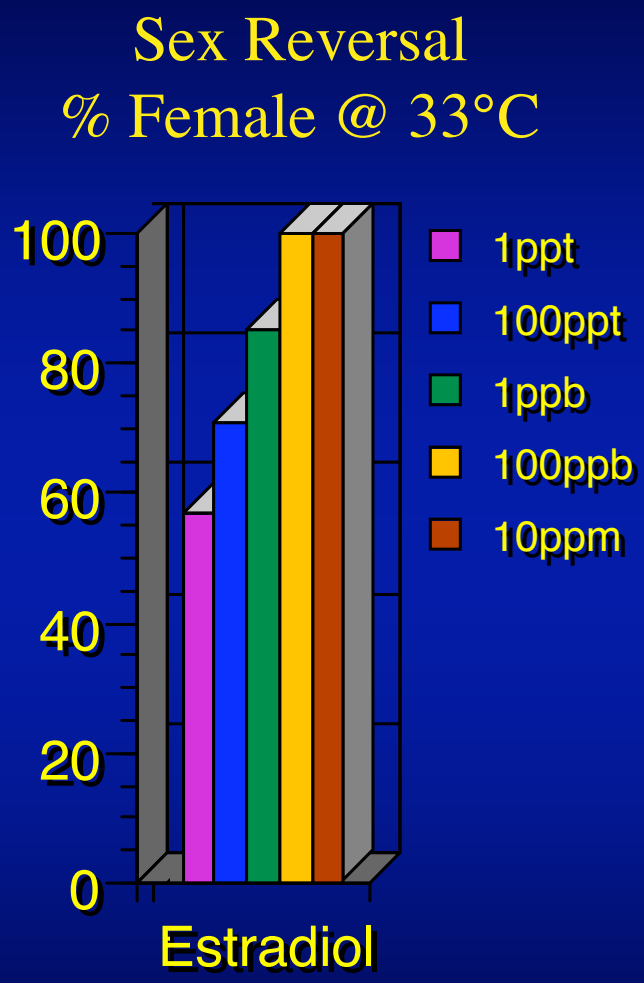
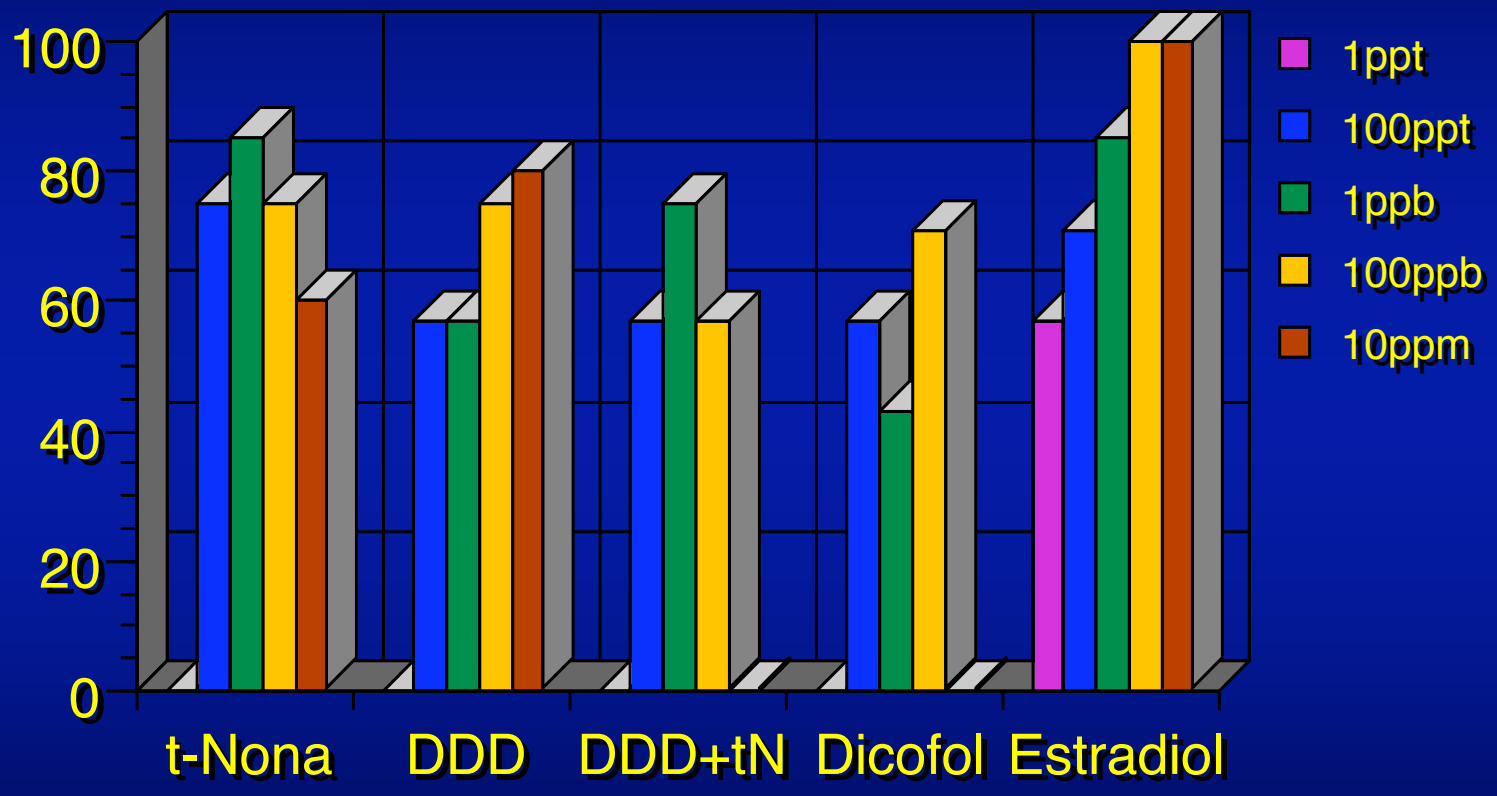
Techniques in Reproductive Biology

Bioassay

- Use of a known biological response
- Develop a dose response curve
- Access unknowns
- Still extensively used



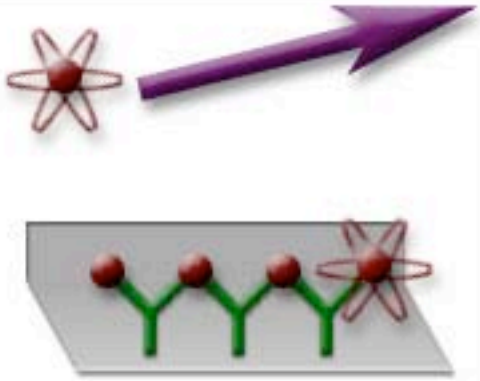
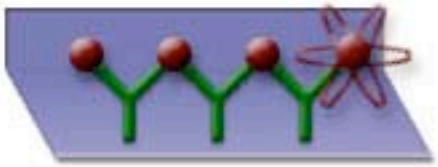
Alligator Sex Reversal



All compounds estrogenic - but not ‘complete estrogen’

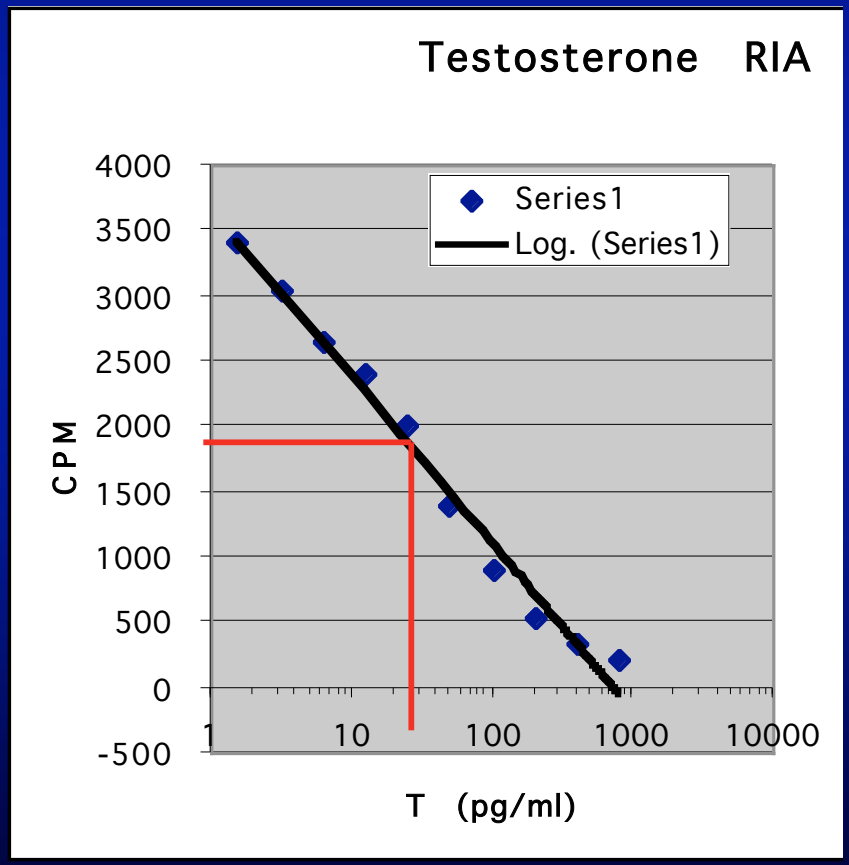
Radioimmunoassay

- Used to measure quantitatively hormone concentrations in blood, receptors in tissue, etc.
- A competitive binding assay using
  - Radio = radioactive label
  - Immuno = specific antibody
  - Assay = quantitative approach

REAGENTS: Ab specific for hormone (coating the filter) Unknown sample with hormone Allow time to react Wash away unbound substances	**POSITIVE SAMPLE** high level of hormone	**NEGATIVE SAMPLE** low level of hormone
REAGENTS: ^{125}I-labeled hormone Allow time to react Wash away unbound radiolabeled hormone		
PROCEDURE: measure radioactivity in a gamma counter RESULT: amount of radioactivity is inversely proportional to the concentration of hormone in the sample.		

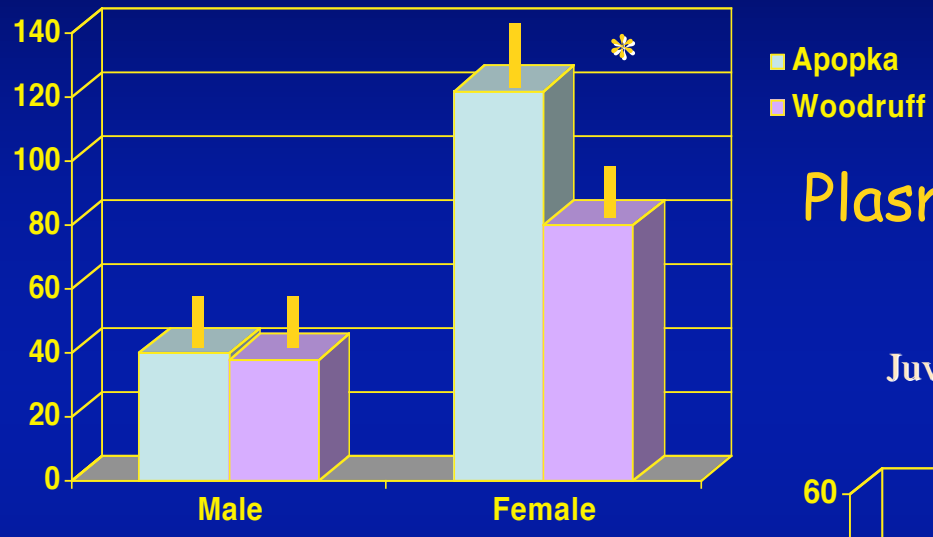
				CPM 1	CPM 2	MEAN CPM
				CPM 1	CPM2	
TC				14595	15187	14891
NSB				87	96	92
B0		0		2919	2898	2909
STD	1	1.5625		2862	2868	2865
STD	2	3.125		2750	2719	2735
STD	3	6.25		2614	2672	2643
STD	4	12.5		2352	2434	2393
STD	5	25		2014	1980	1997
STD	6	50		1414	1388	1401
STD	7	100		935	869	902
STD	8	200		535	511	523
STD	9	400		308	339	324
STD	10	800		209	206	208

- 1900 cpm = 28 pg/tube
- If:
  - 100 µl/tube
- Then
  - Concentration in ml
  - 10 X 28 pg/tube
  - 280 pg/ml



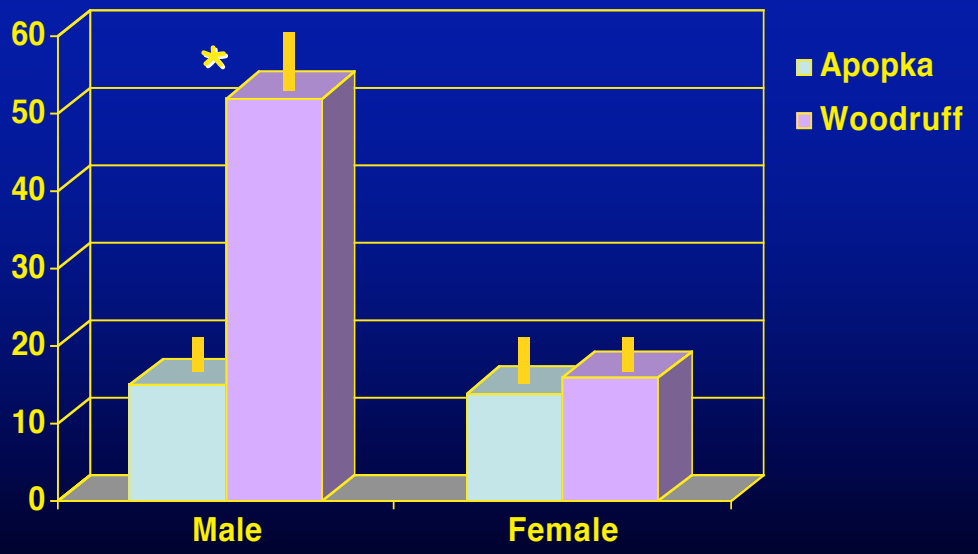
Plasma Estradiol (pg/ml)

Juvenile Alligators - 9 mo old



Plasma Testosterone (pg/ml)

Juvenile Alligators - 9 mo old



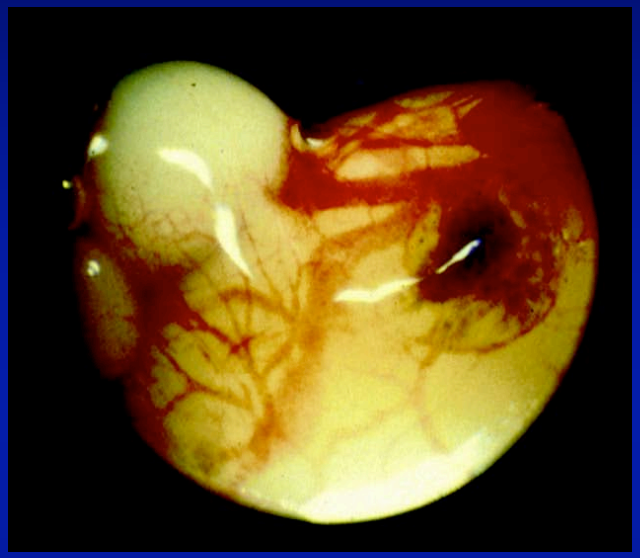
Guillette et al. (1994) Environ. Health Perspec. 102:680-688

Surgery

- Earliest technique
  - 1) "Extirpation"
    - Remove tissue
  - 2) See what happens
  - 3) Replacement
  - Still used extensively
  - Interpretation can be difficult

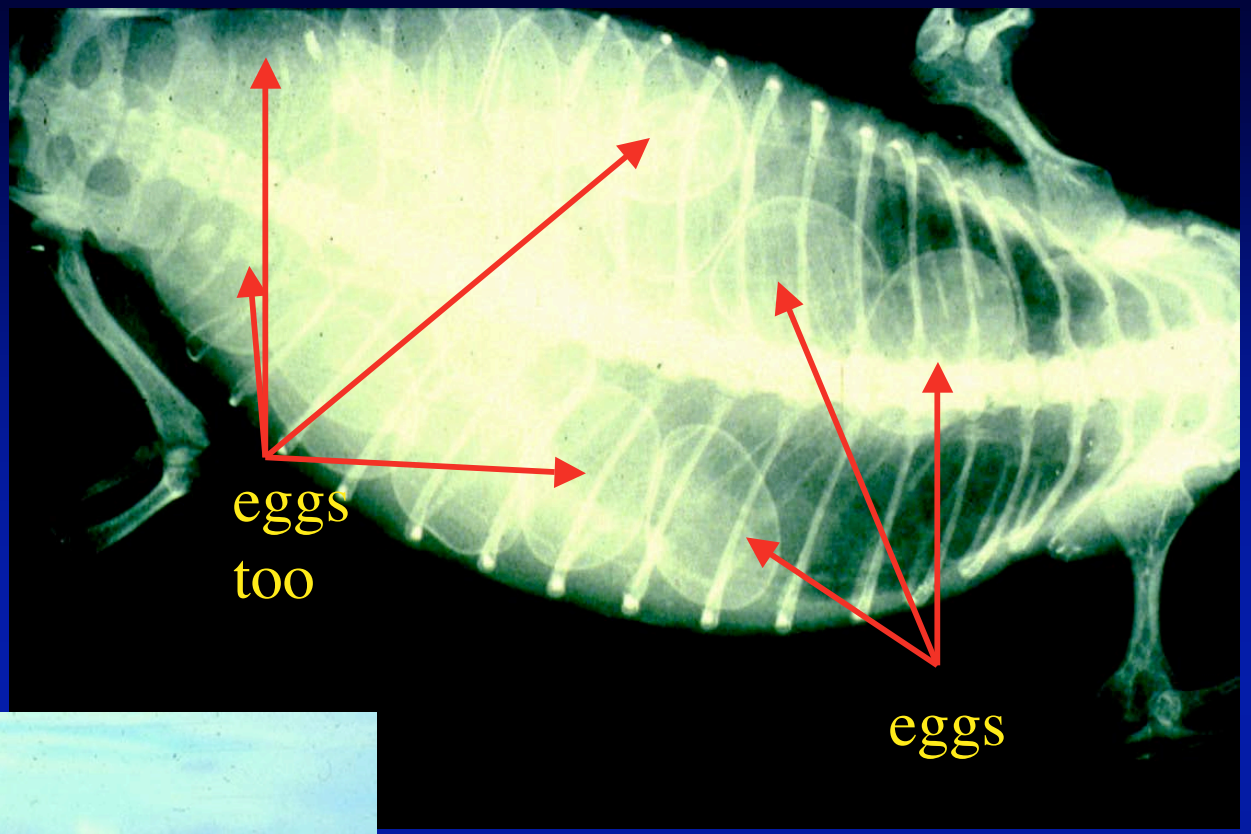
X-Ray & Other Imaging

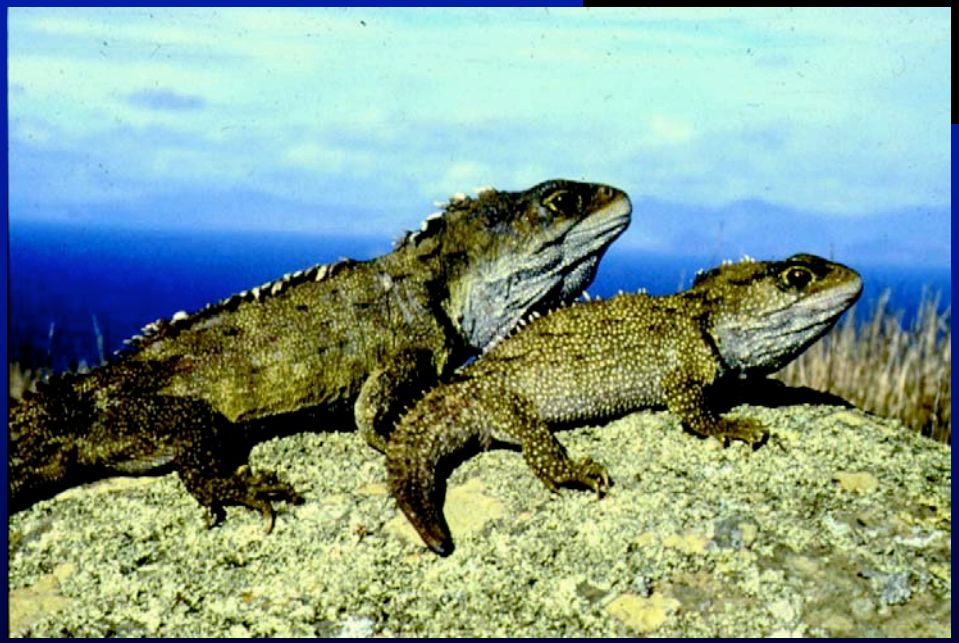
- Modern imaging technology extensive
  - X-ray; MRI; CAT scan
- Used for non- to minimally invasive 'view'
- Can provide extensive information



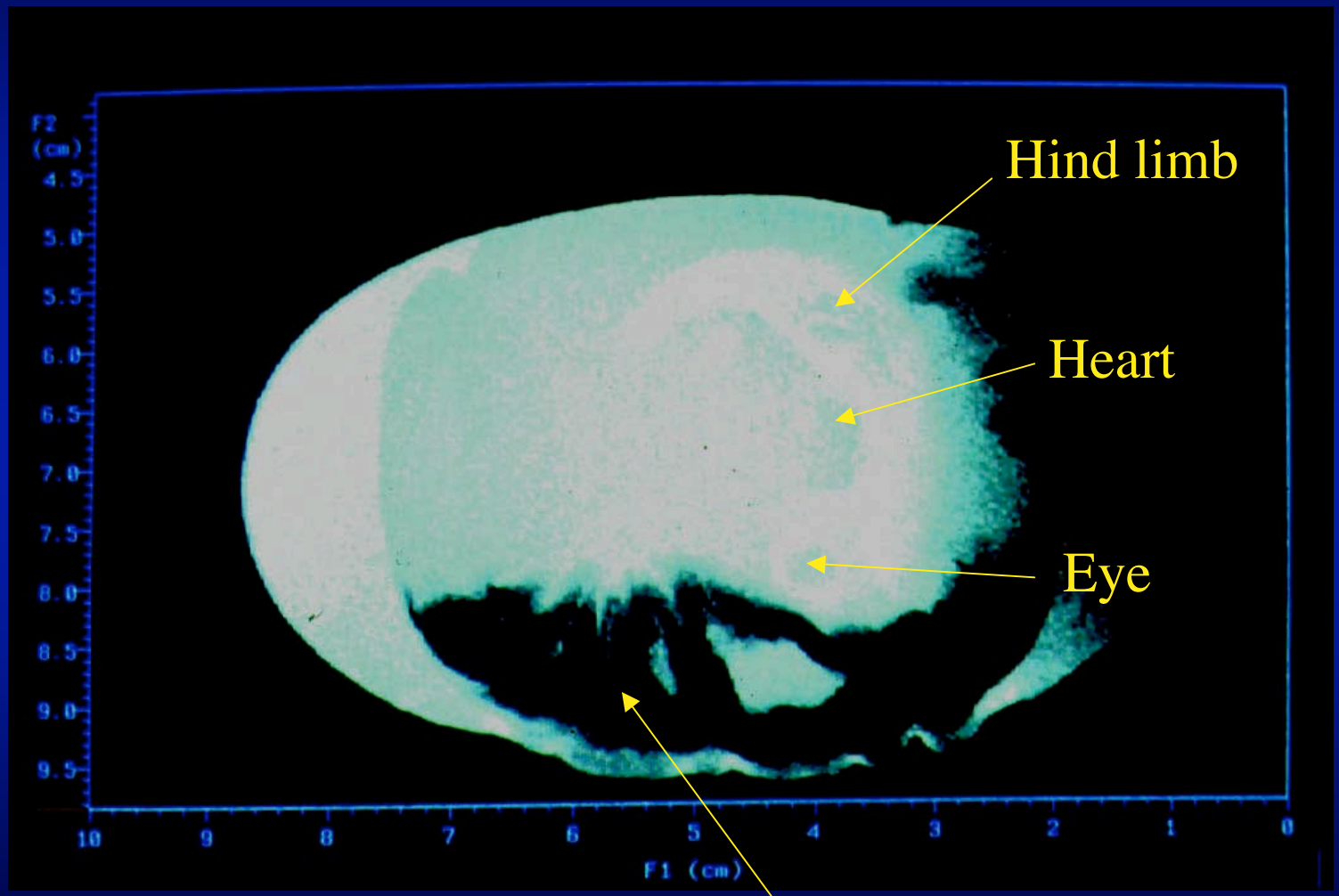
Laparoscopy of Tuatara ovary

X-ray of gravid tuatara



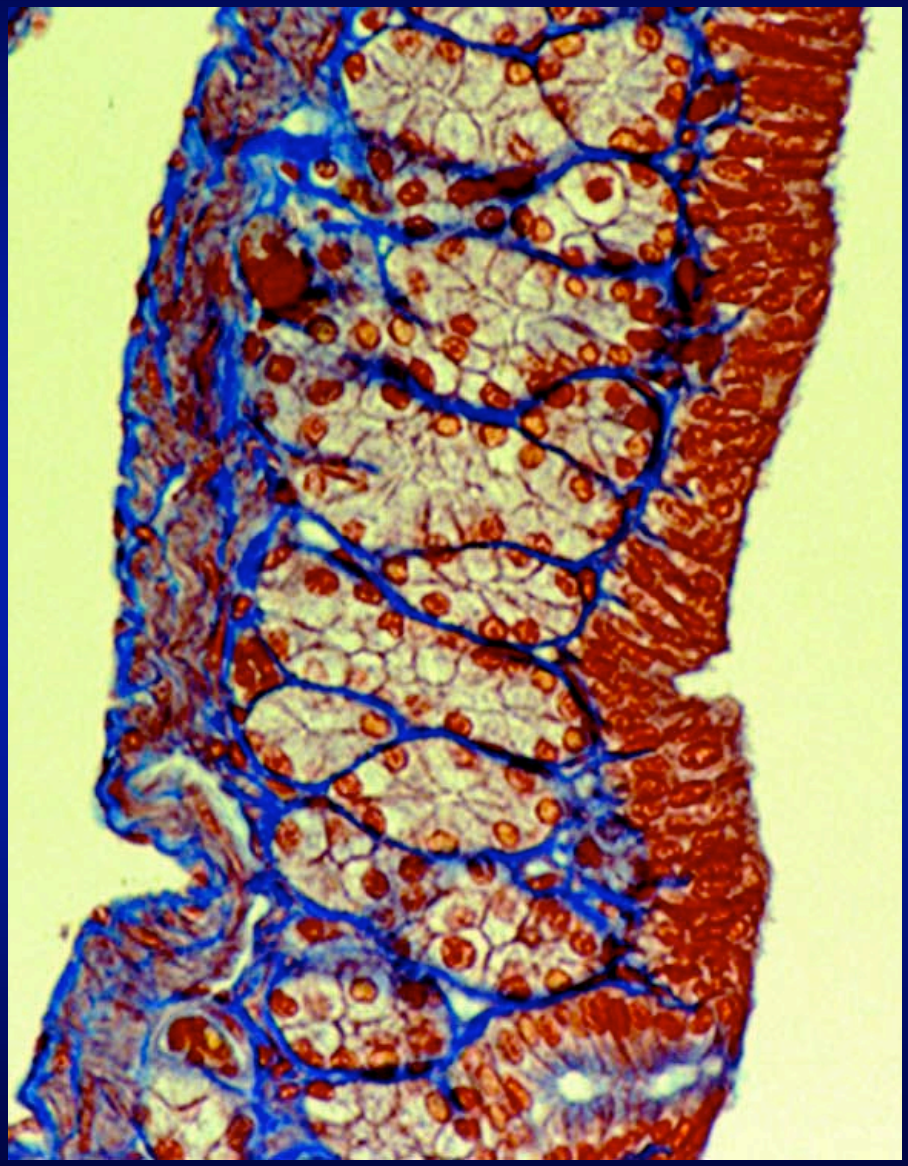


MRI of an
Alligator egg



Histology

- Sections of tissues cut at micrometer thickness or smaller
- Provides view of tissue at cellular or subcellular level
- Initial process of many other processes



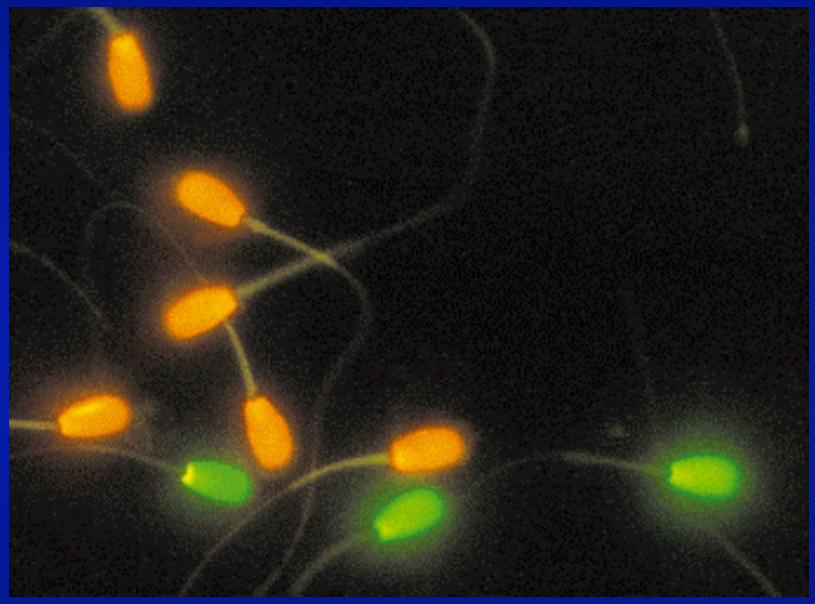
SEM/TEM

- Electron microscopy allows sub cellular view of cells
- Powerful tools for anatomy and physiology
- SEM: tissue dried - coated with gold
- TEM: tissue fixed - cut at < 1 μm

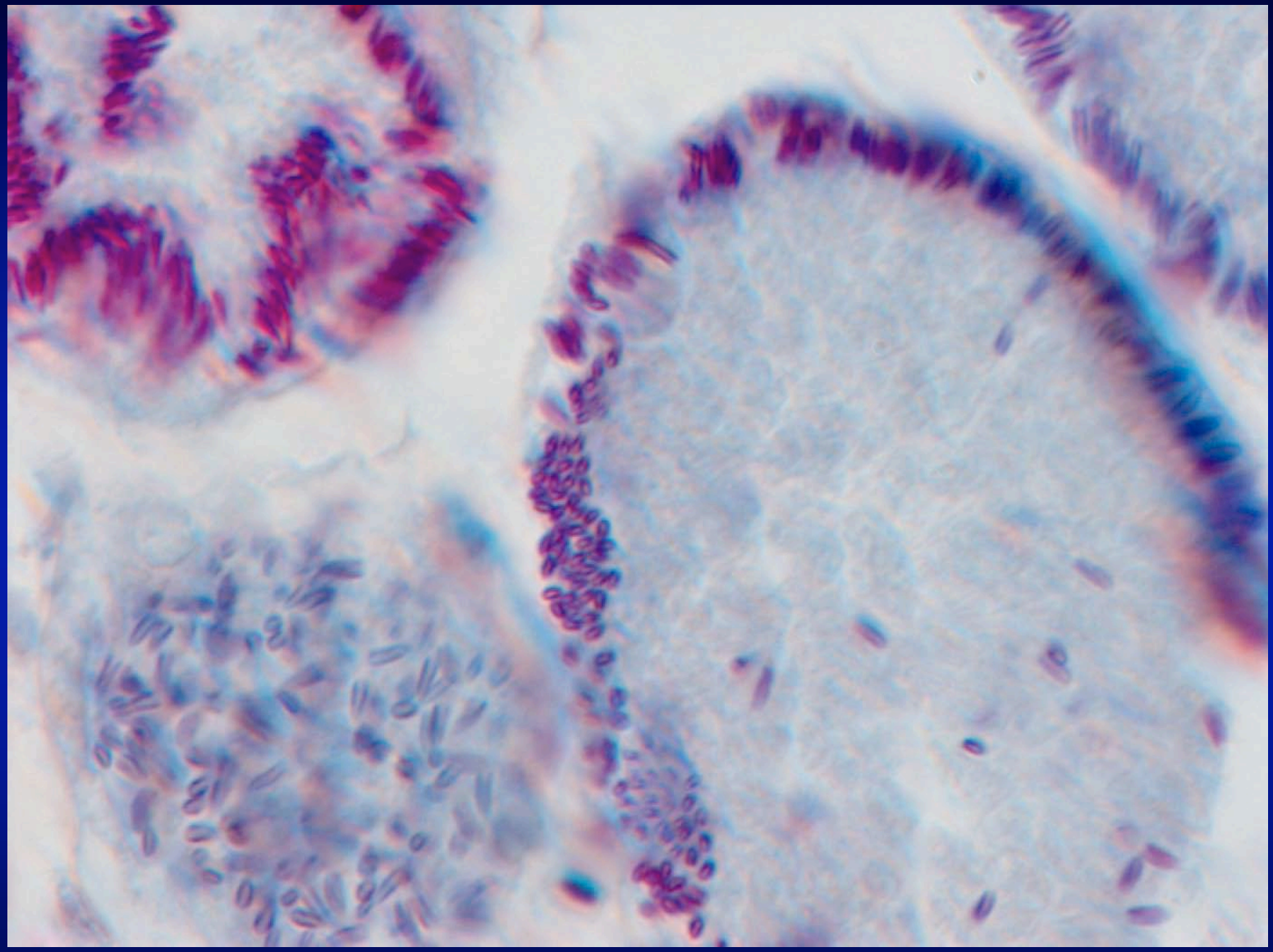
SEM of uterine surface with
Egg shell fibers extruding

Histochemistry

- Used to examine specific enzymatic reactions of cells
  - Can be used to identify pathological tissues
  - Or live and dead tissue



- Bull sperm
  - live - green
  - dead - red

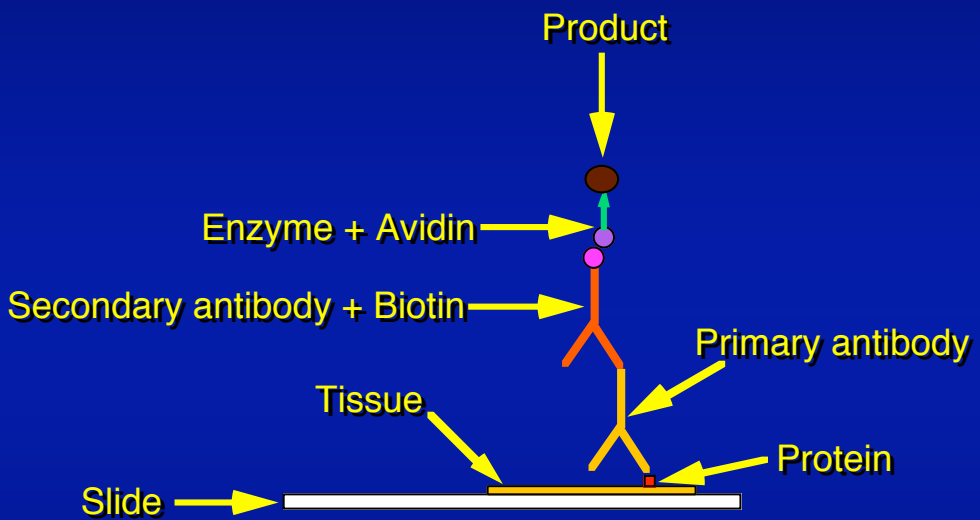


Gambusia holbrooki

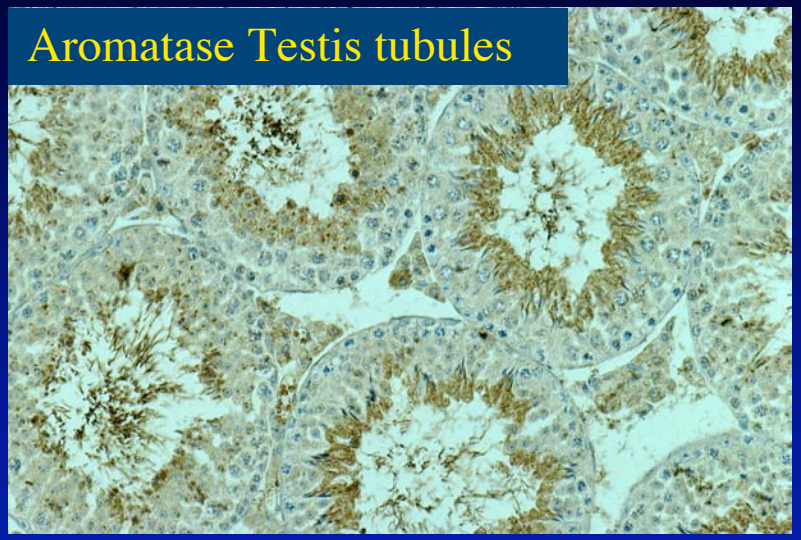
Immunocytochemistry

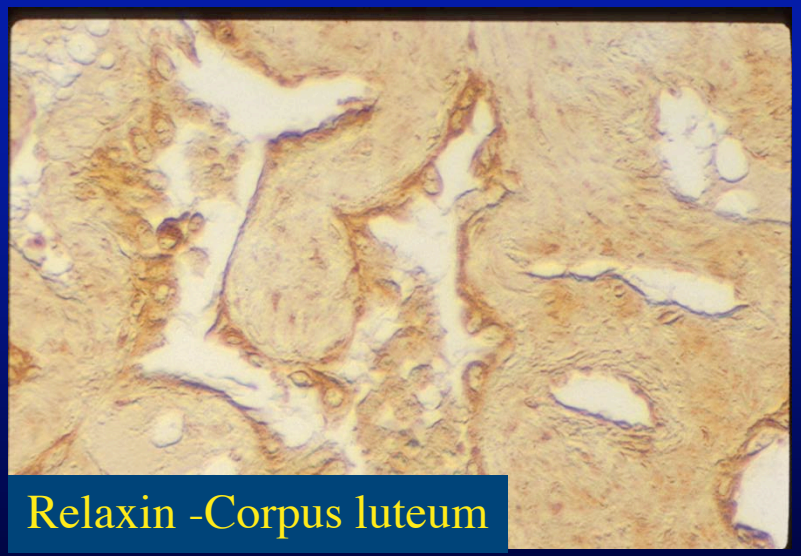
- Used to identify ***location*** of protein in a cell/tissue
- Use of a specific antibody and targeted enzyme reaction

Immunocytochemistry

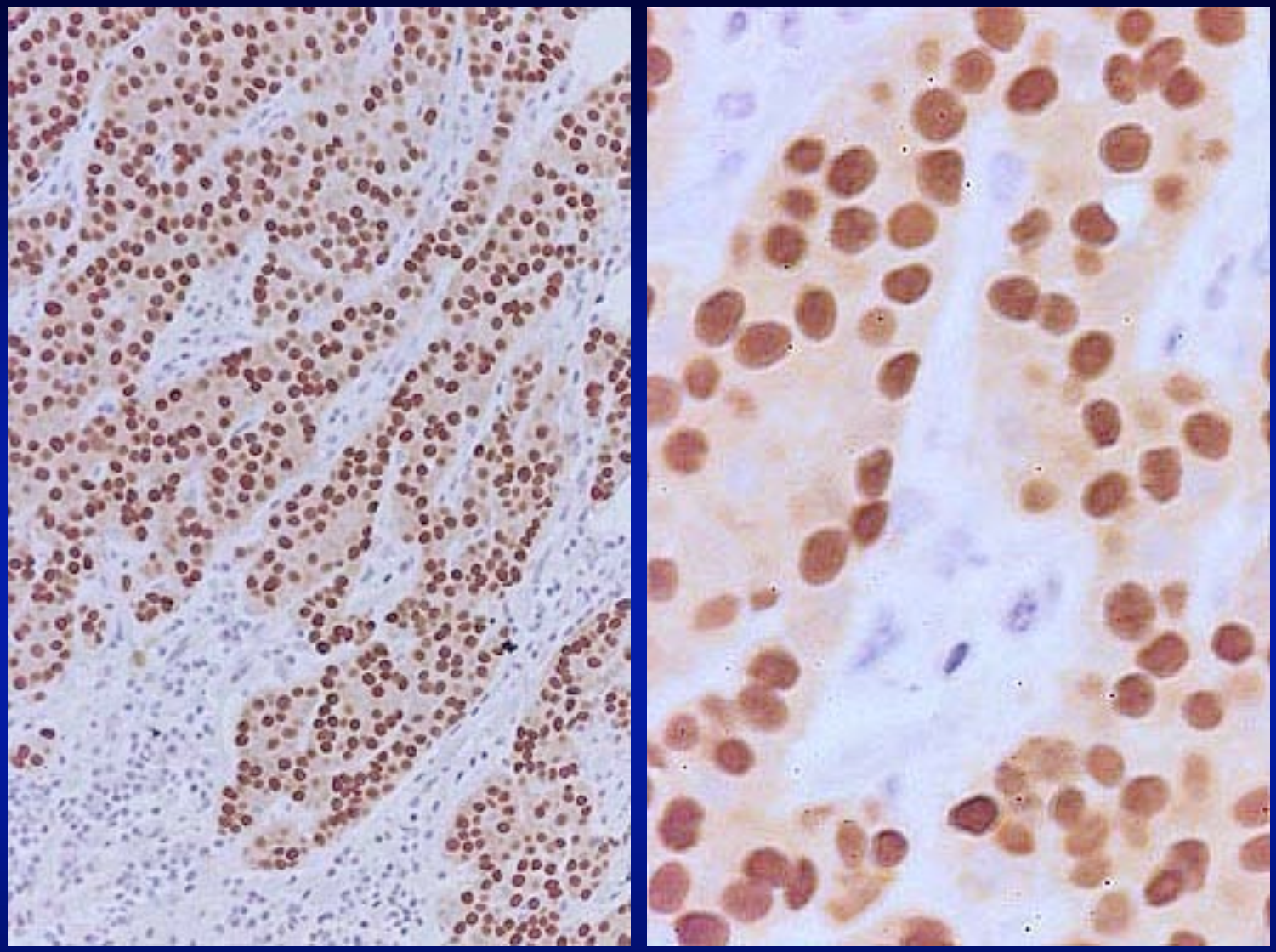


Aromatase Testis tubules





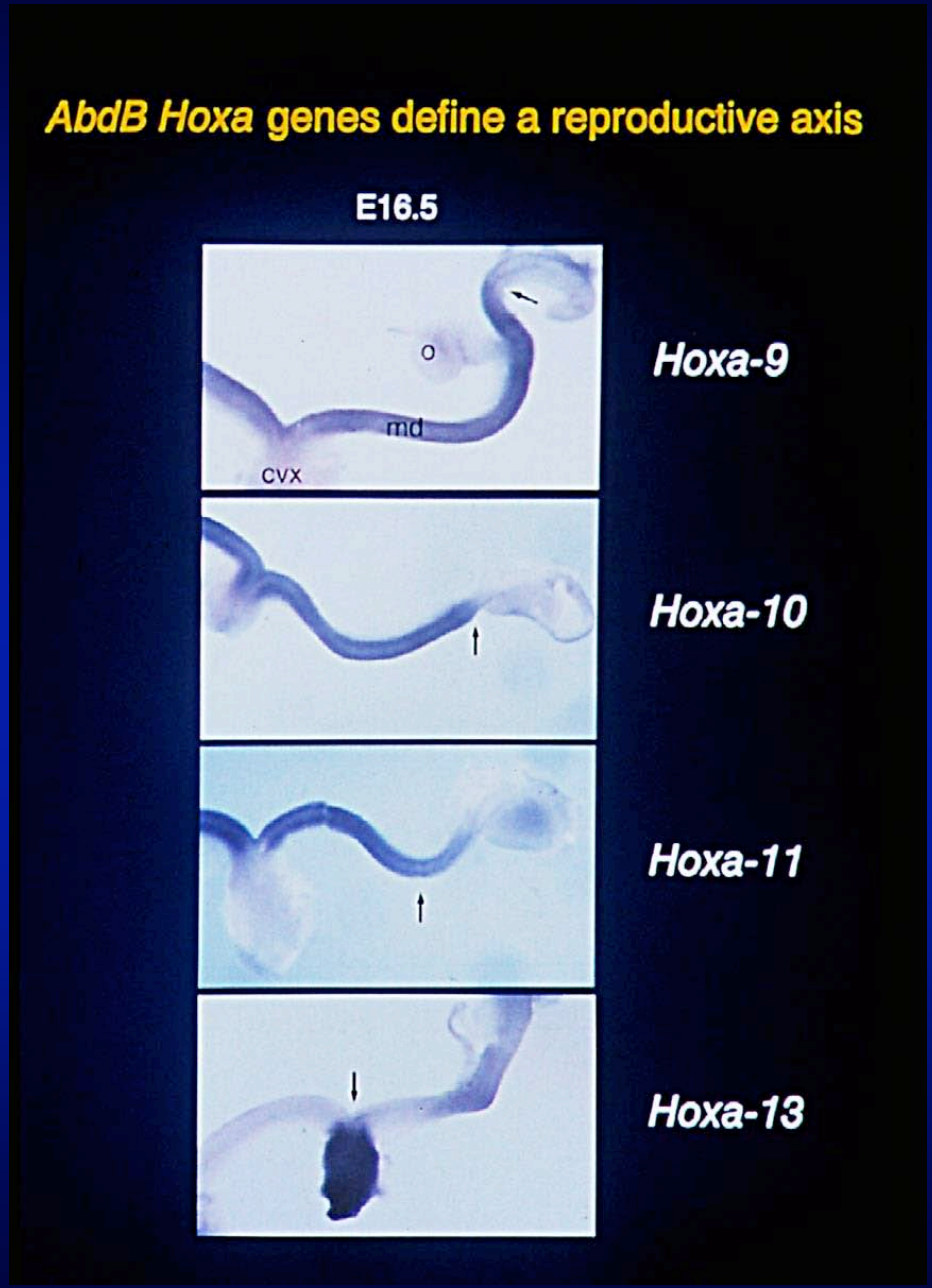
Relaxin -Corpus luteum



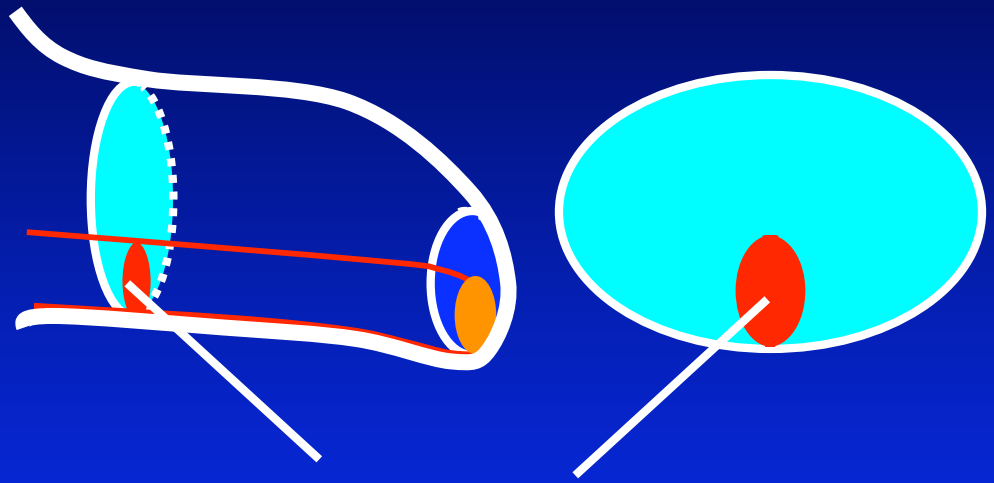
ICC for ER in Uterine tissue

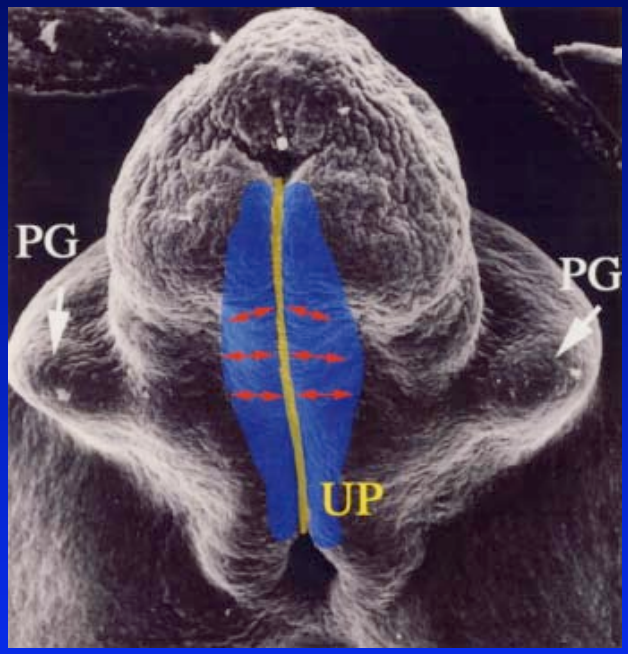
In situ Hybridization

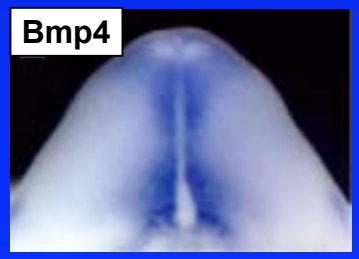
- Used to localize specific mRNA in tissue or cell
- Targeted probe complementary to the mRNA



Gene expression pattern during genital tubercle development

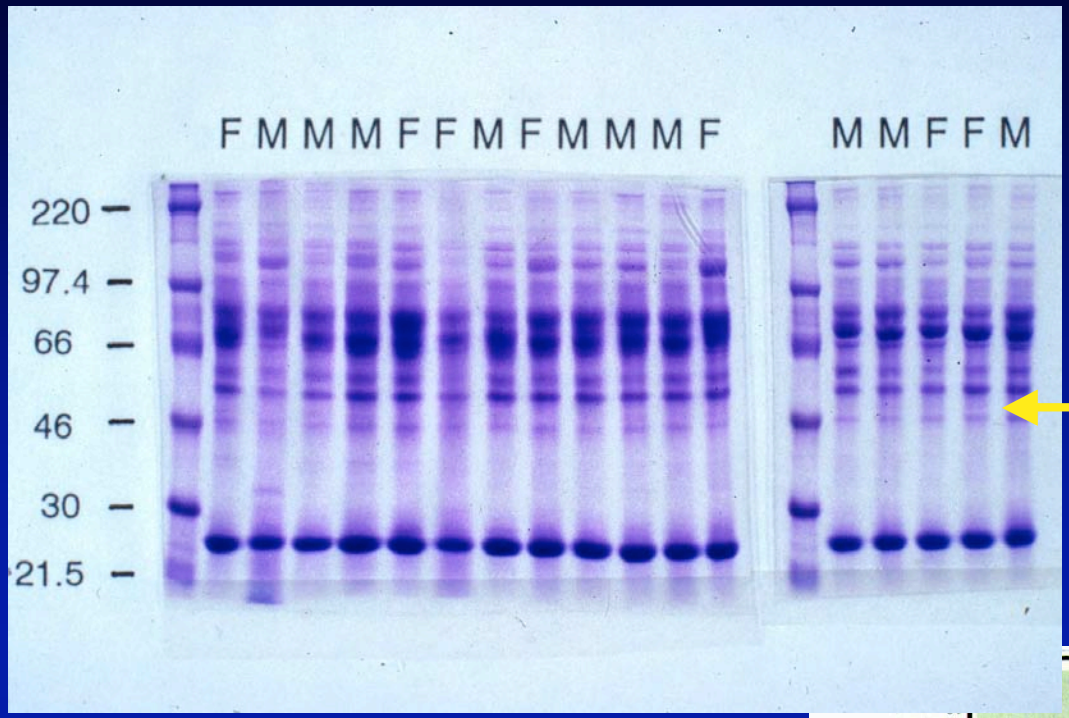






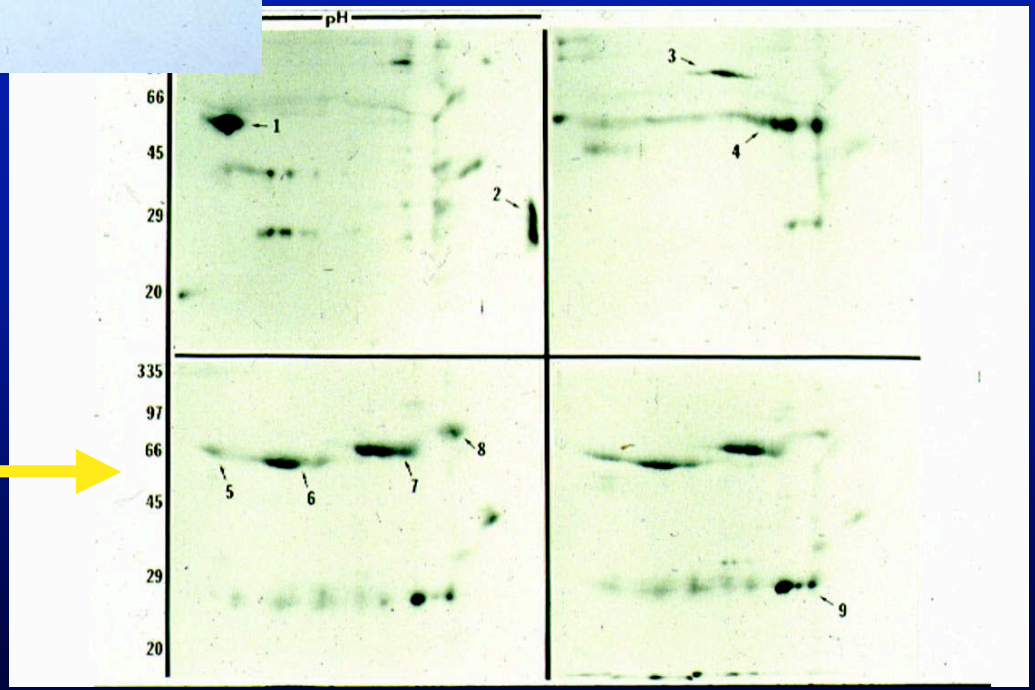
Electrophoresis

- Use molecular weight &/or charge to separate chemicals
  - proteins or RNA or DNA commonly isolated using electrophoresis
  - 1 or 2 dimensions



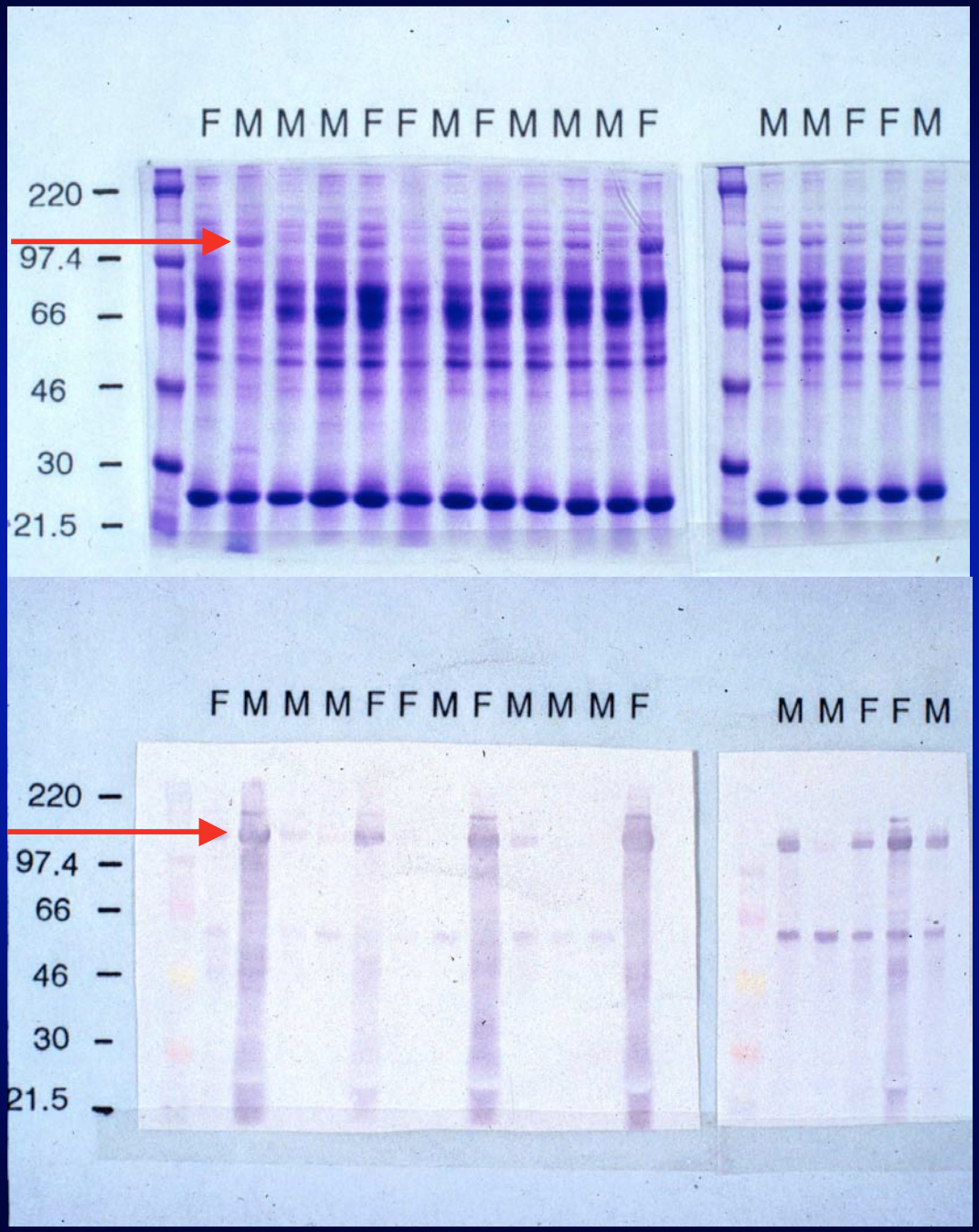
1D-SDS PAGE for
Serum proteins in fish

2D-SDS PAGE for
Oviduct proteins in gator



Western blots

- Protein from electrophoretic gel transferred to membrane
- 'Stained' with a specific antibody
  - ICC on gel blot
- Identifies a specific band associated with a specific protein

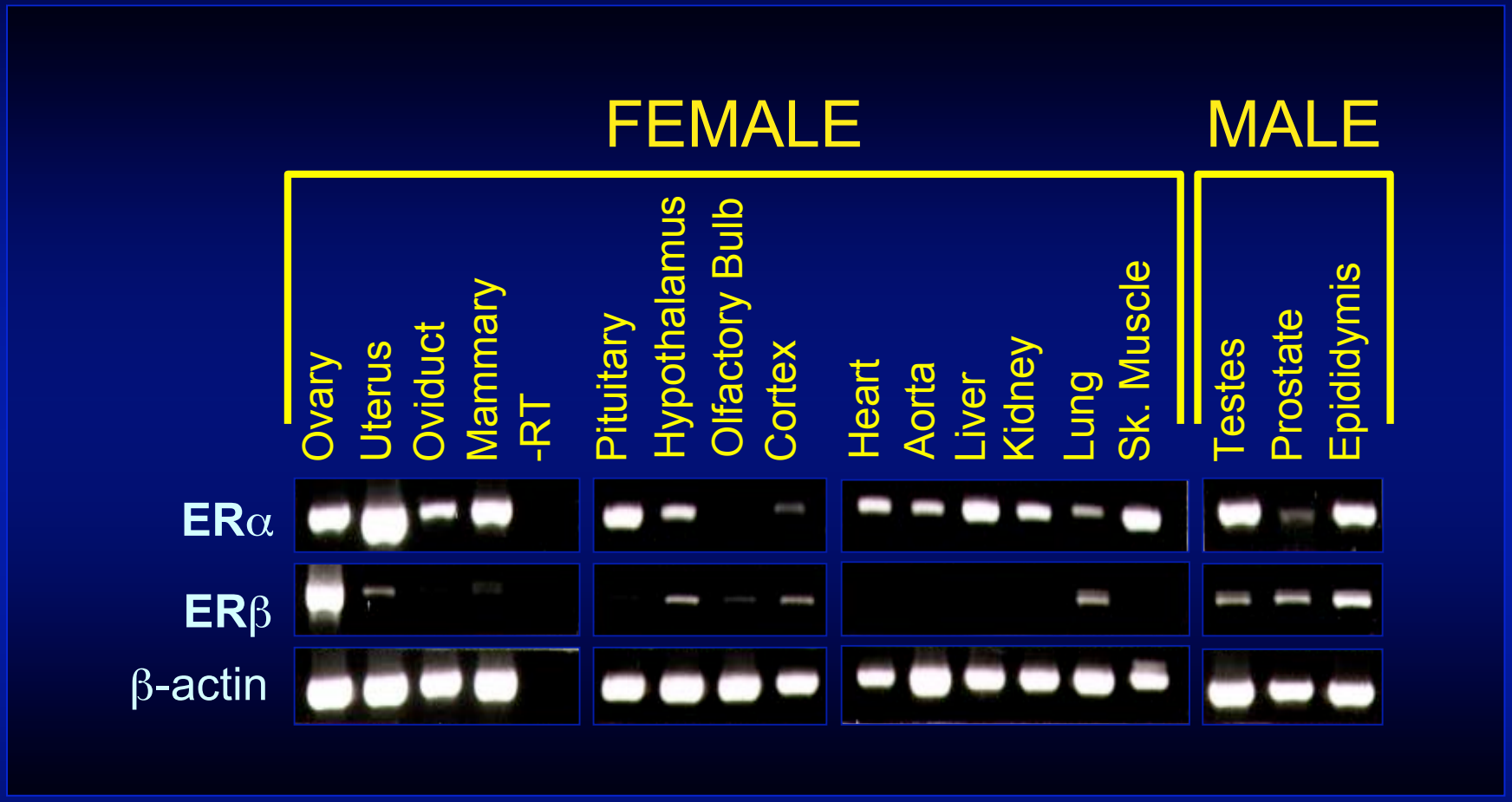


1D PAGE for Vtg

Western for Vtg

RNA/Northern Blot

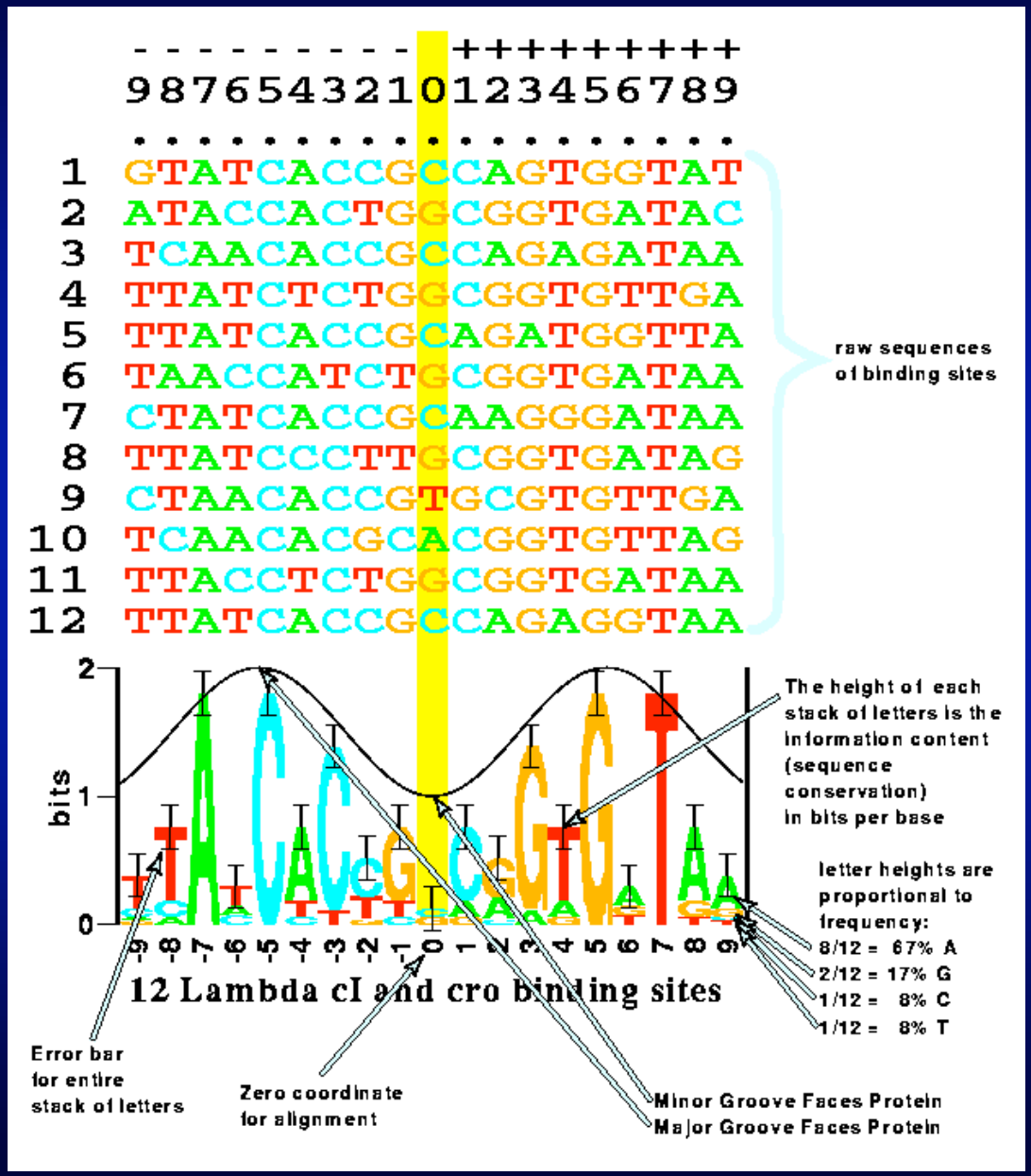
- Electrophoresis of RNA
- Transfer to membrane and probe with complementary radioactive cDNA
- Expose X-ray film/plate



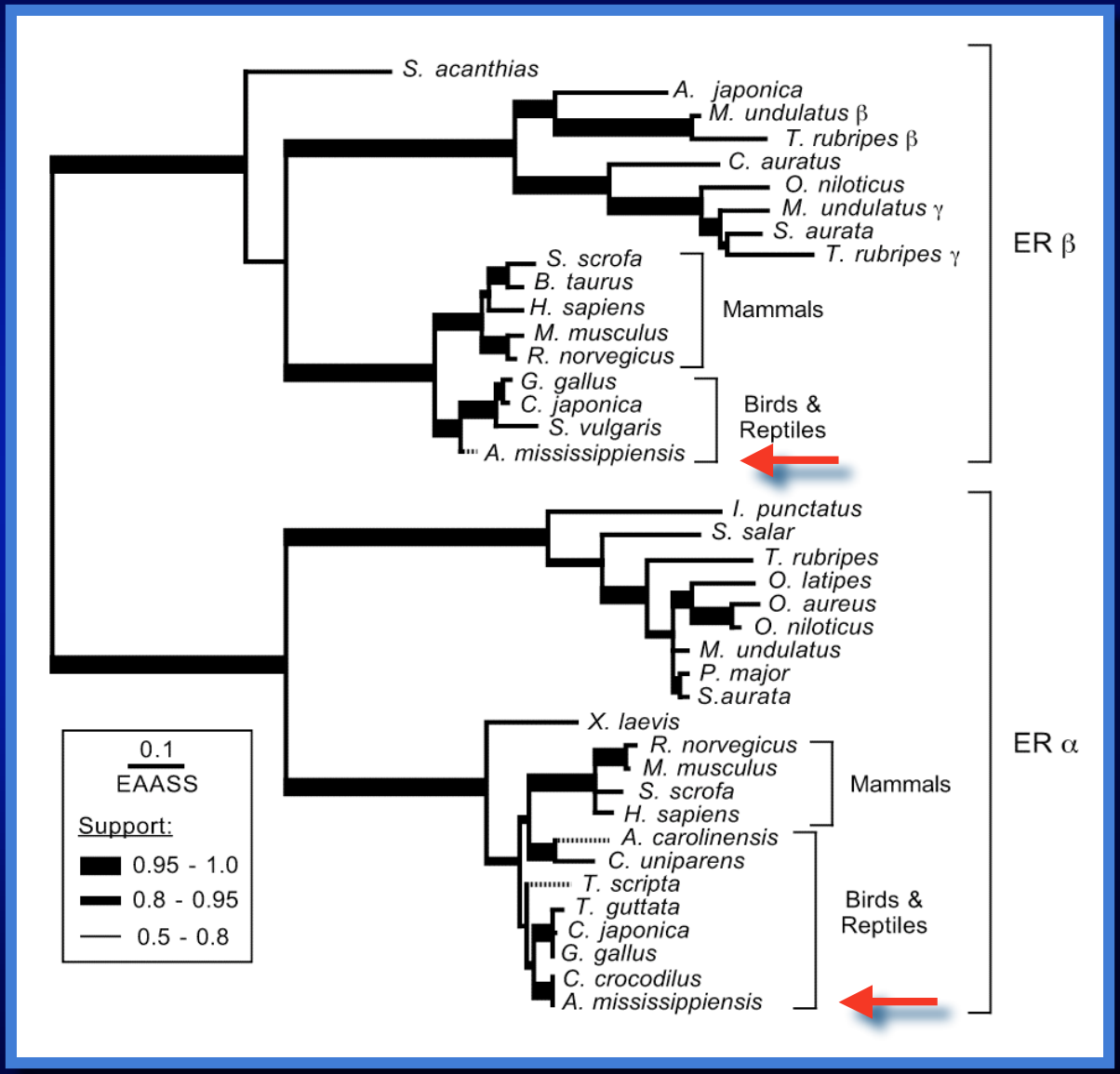
JF Couse and KS Korach (1999) *Endocrine Reviews*. 20:358-417.
JF Couse et al. (1997) *Endocrinology*. 138:4613-4621.

Couse, 1999

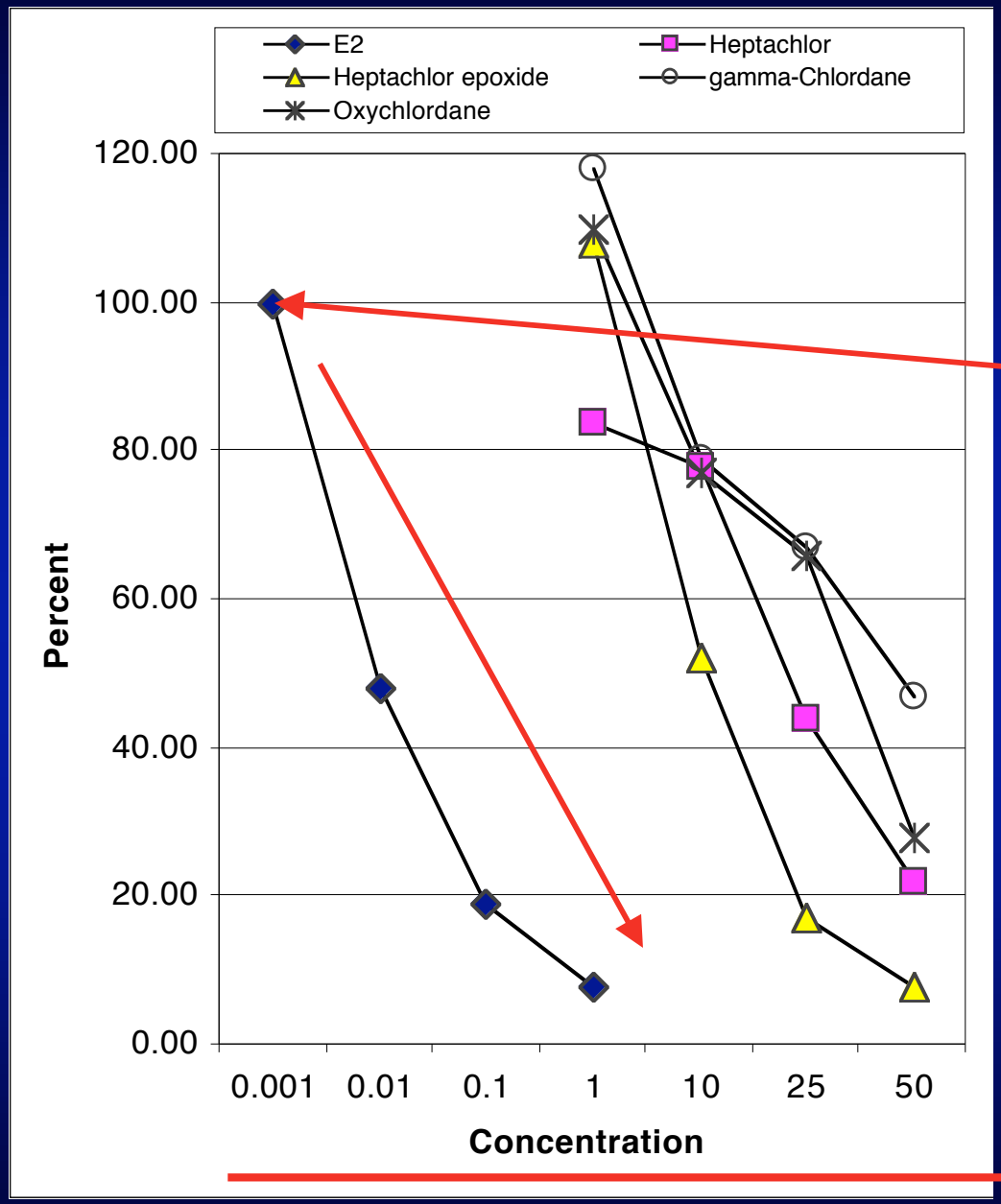
DNA Sequencing



Phylogeny of ER



Katsu, et al., Gen. Comp. Endo. (2003)



Competitive Binding Assay for Receptor Binding

load receptor with radioactive estrogen

decaying curve

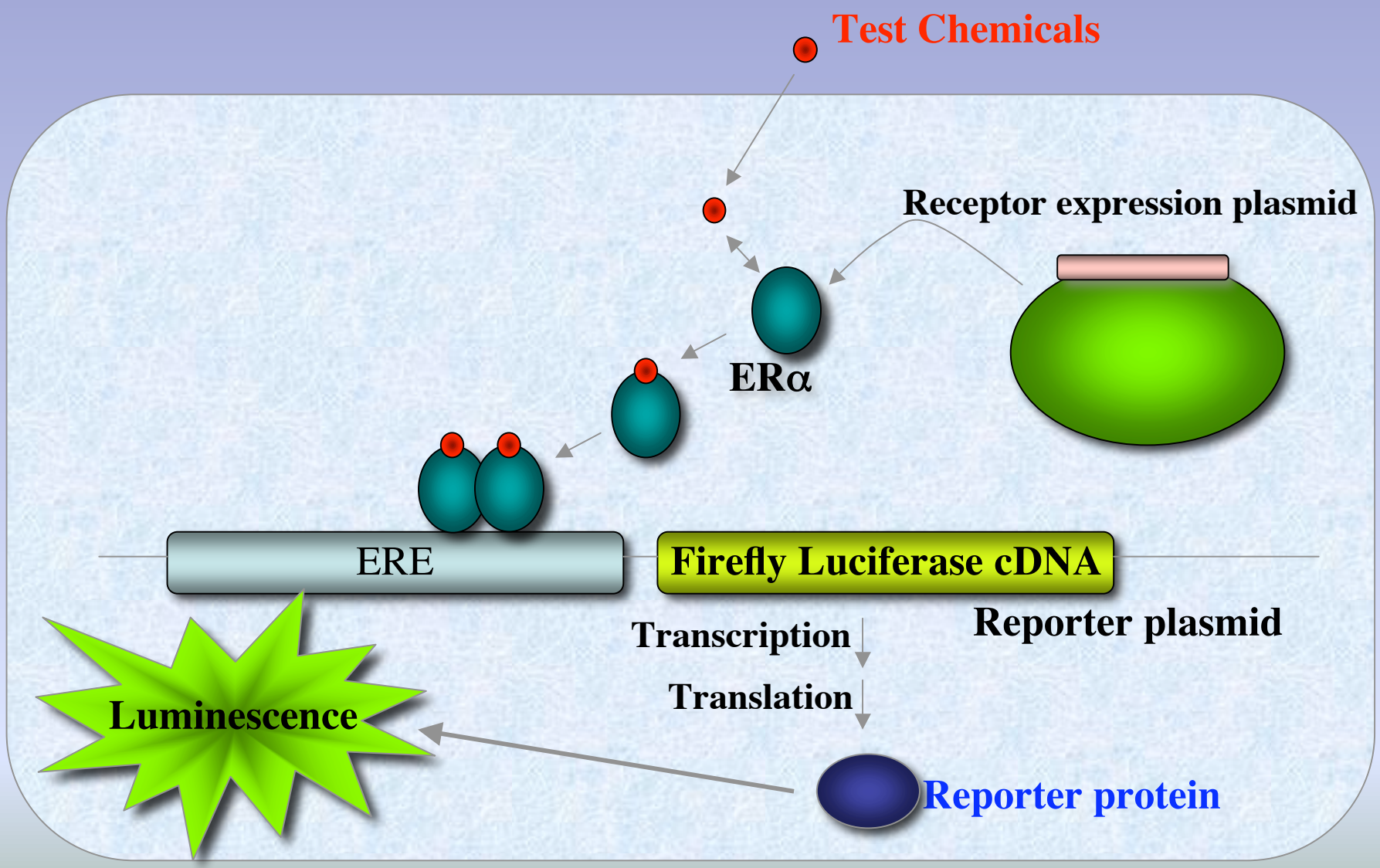
Increase 'cold' estrogen

ER Binding

Transfected Cell Line

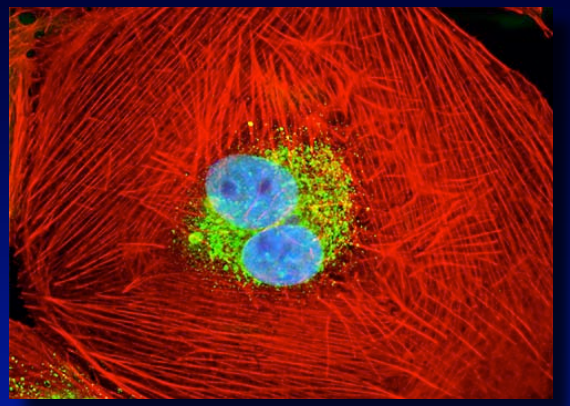
- Develop a test 'organism'
- Insert a receptor-gene construct if interest for testing
  - Human ER or AR with reporter gene

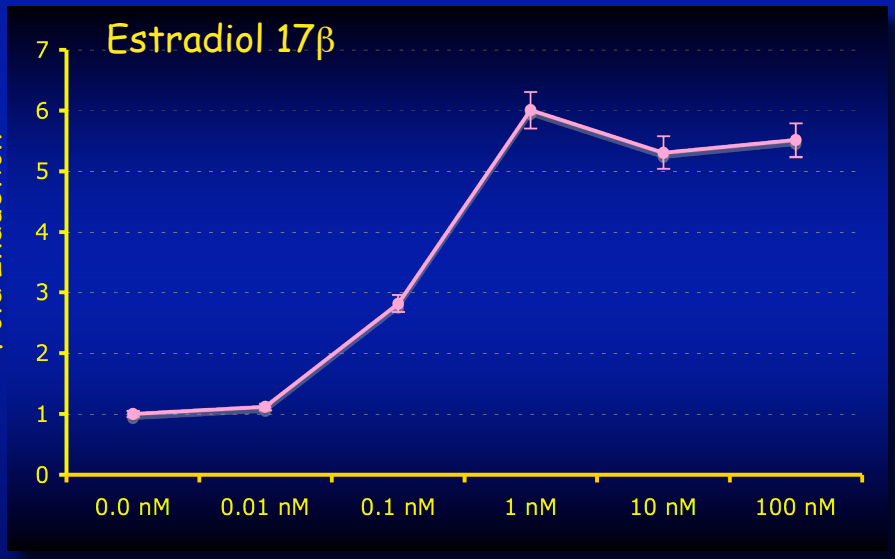
Reporter Gene Assay using ERE-Luc

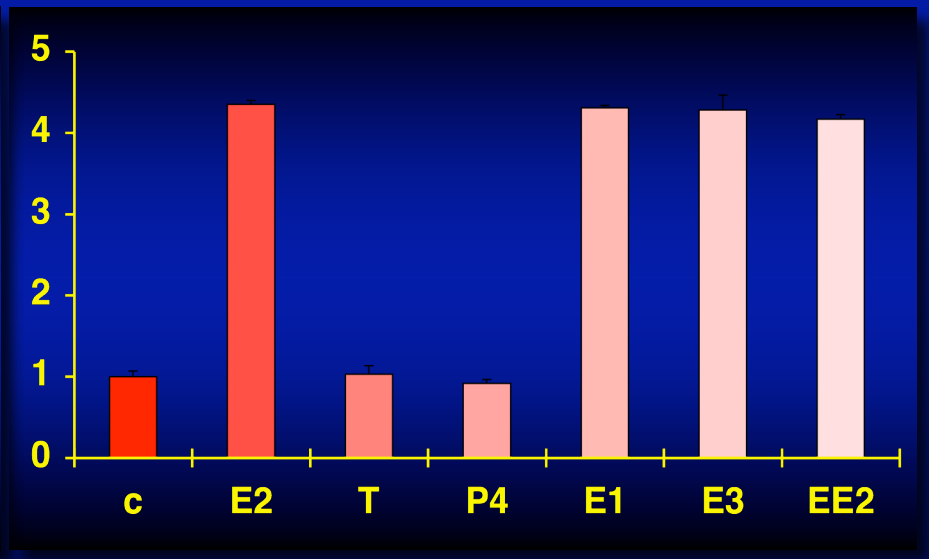


In vitro Gene Expression with aERα

CHO-K1 cells transfected with aERα

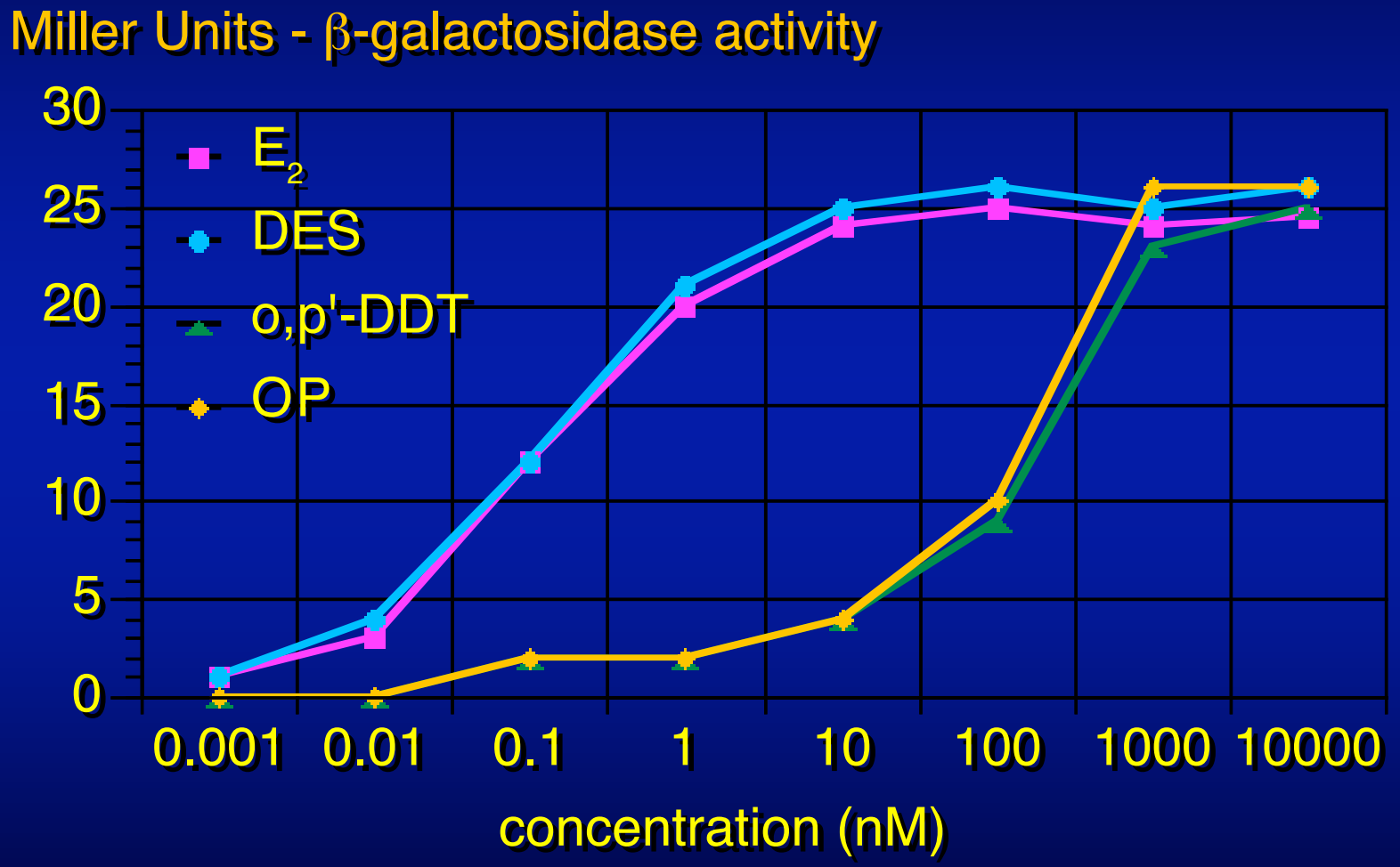




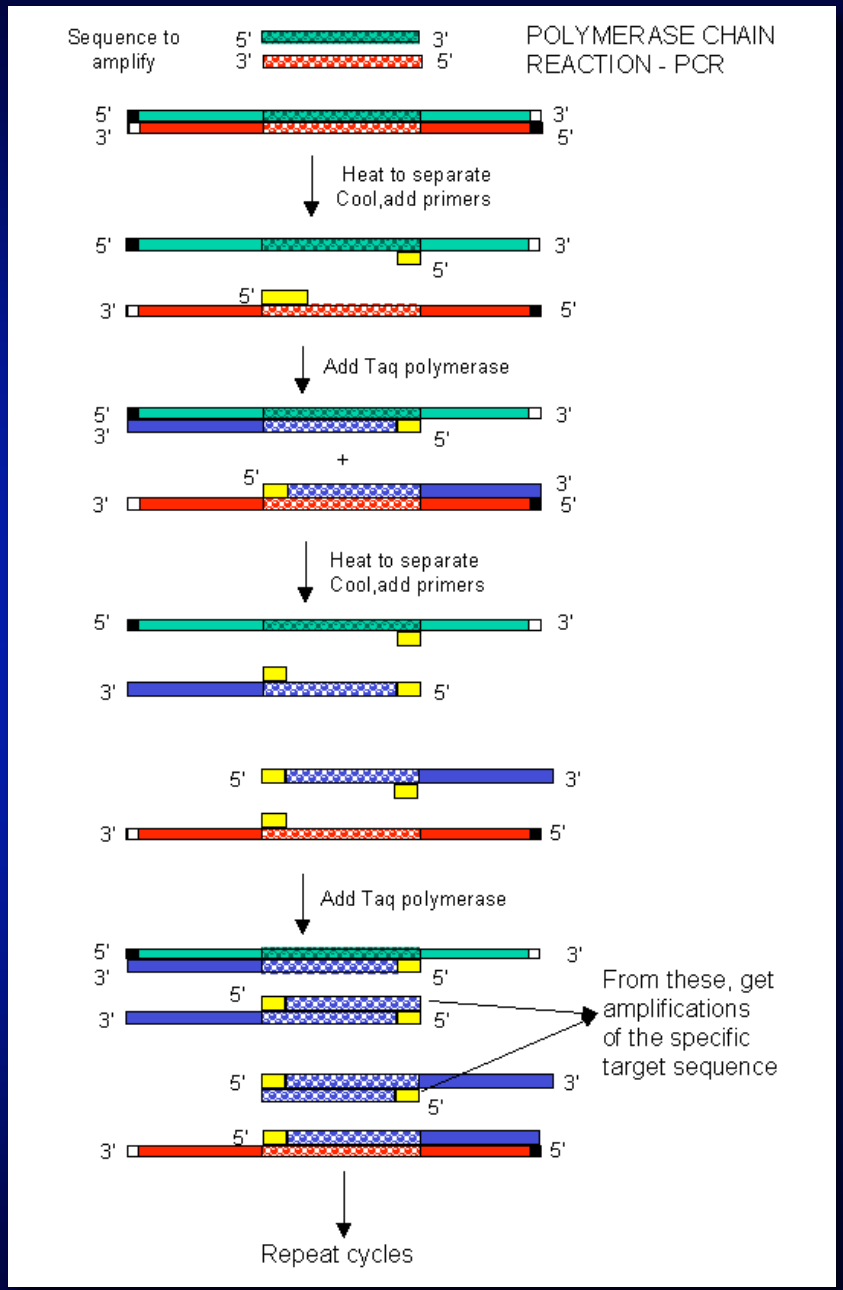


Katsu et al. unpubl data

Yeast Estrogen Screen (YES) Assay

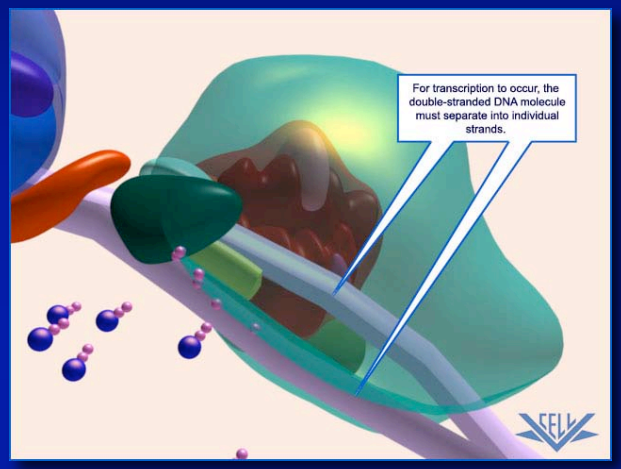


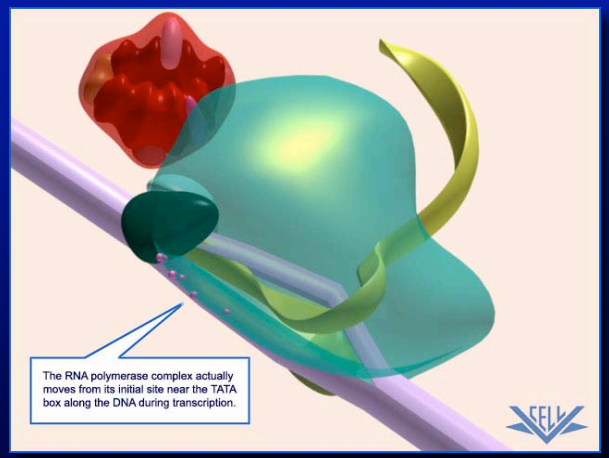
Arnold et al., 1996, Environ. Health Perspec.



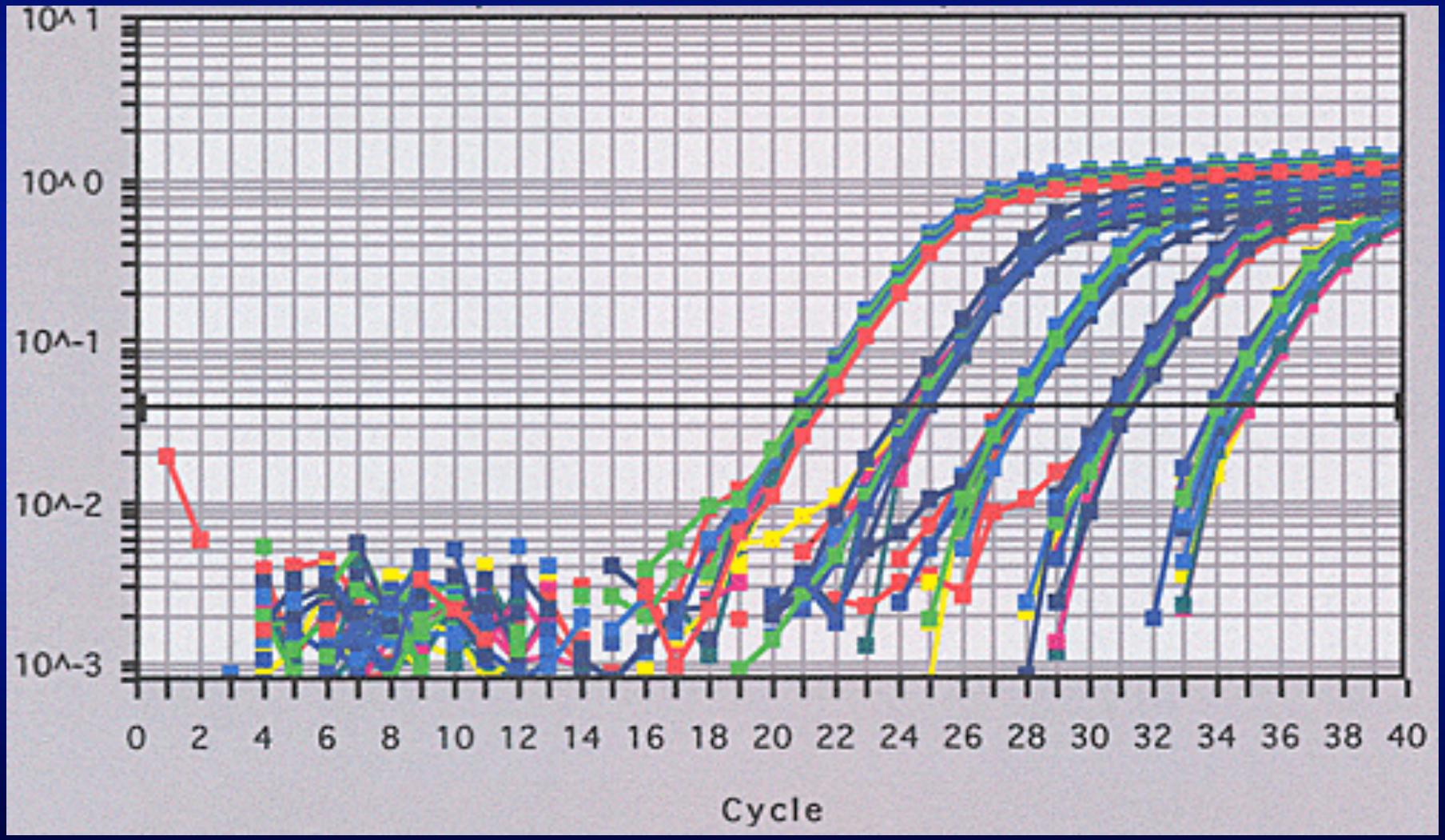
PCR

- Use of natural DNA/RNA mechanisms





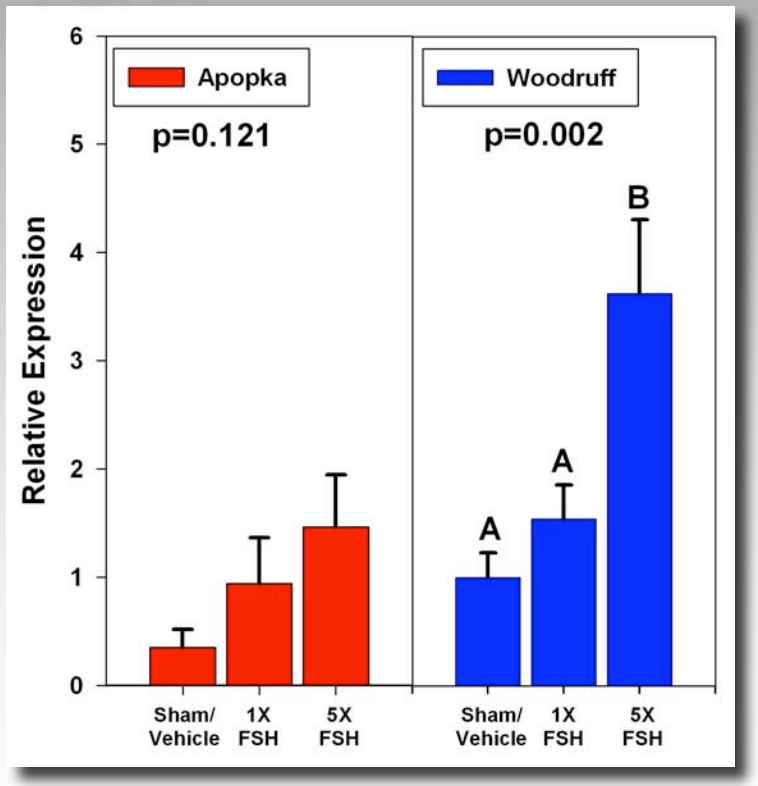
Quantitative Real Time PCR



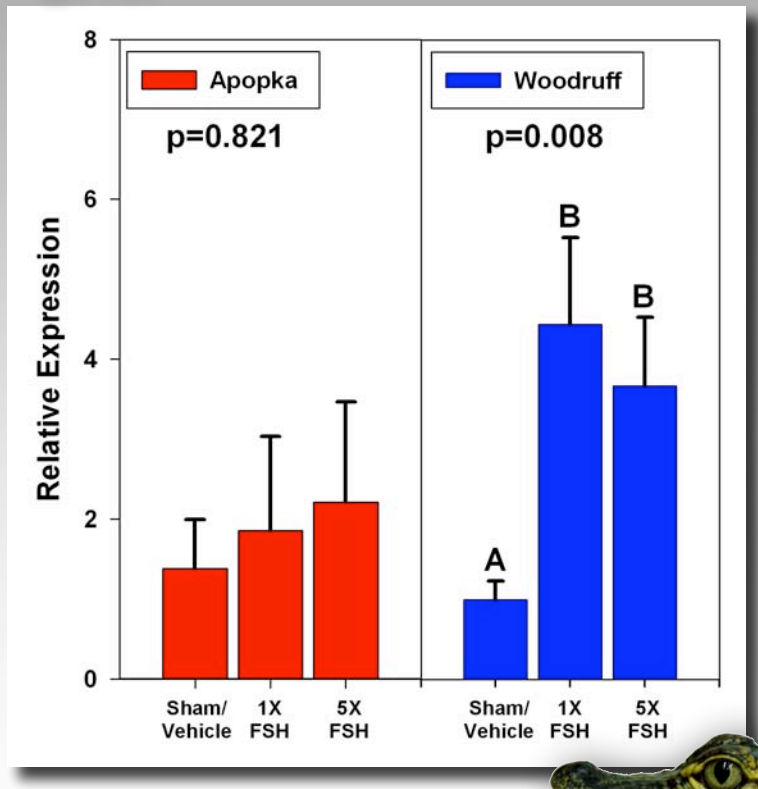
FSH Changes Ovarian Gene Expression

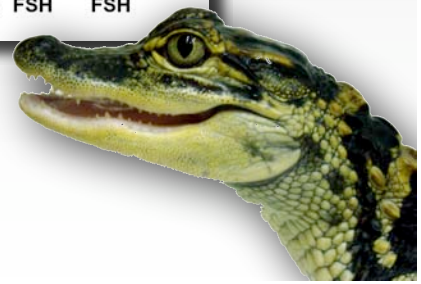
Quantitative Real Time - PCR

FSHR



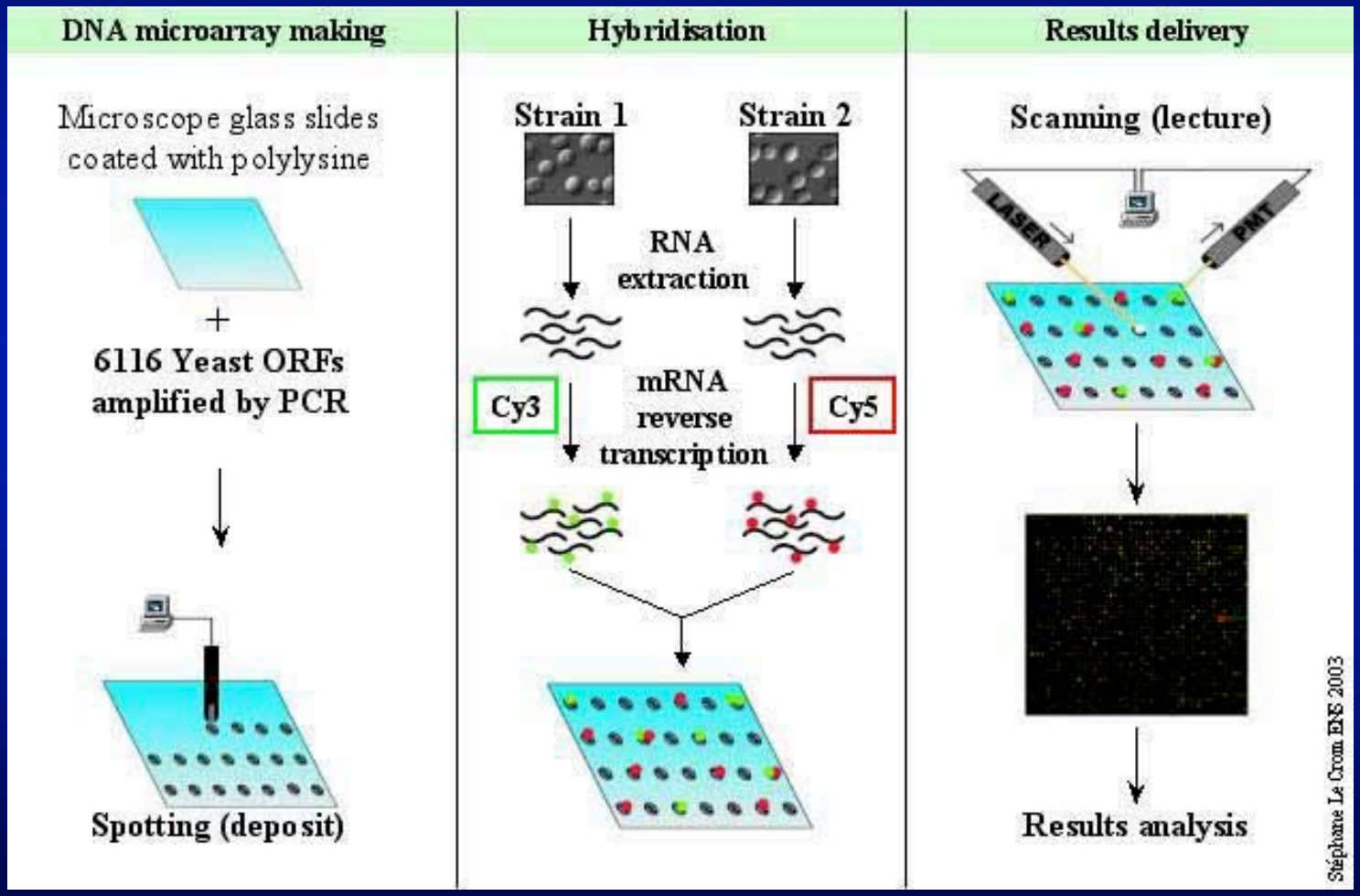
ERα

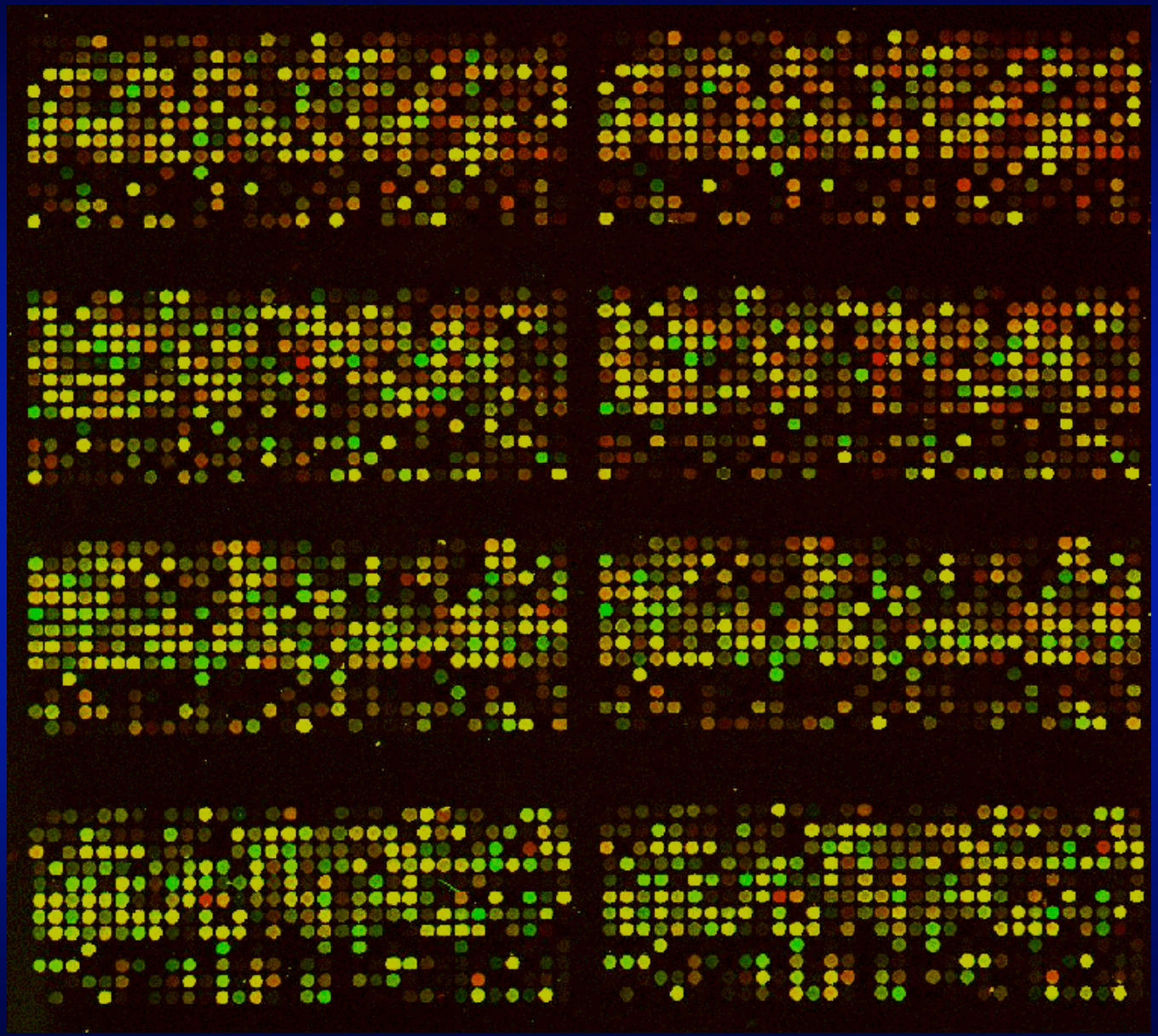




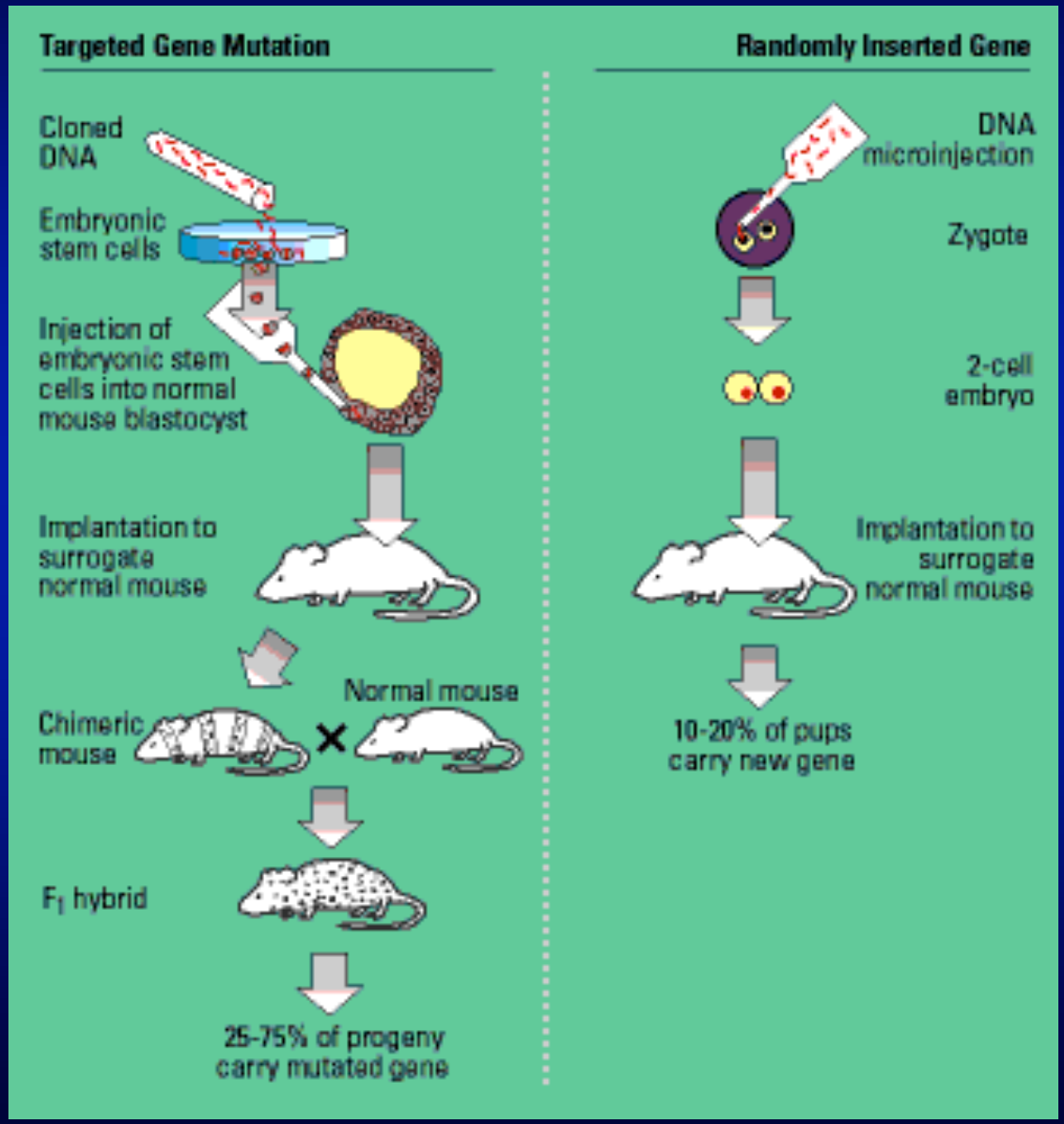
Moore et al. unpubl. data

Microarray

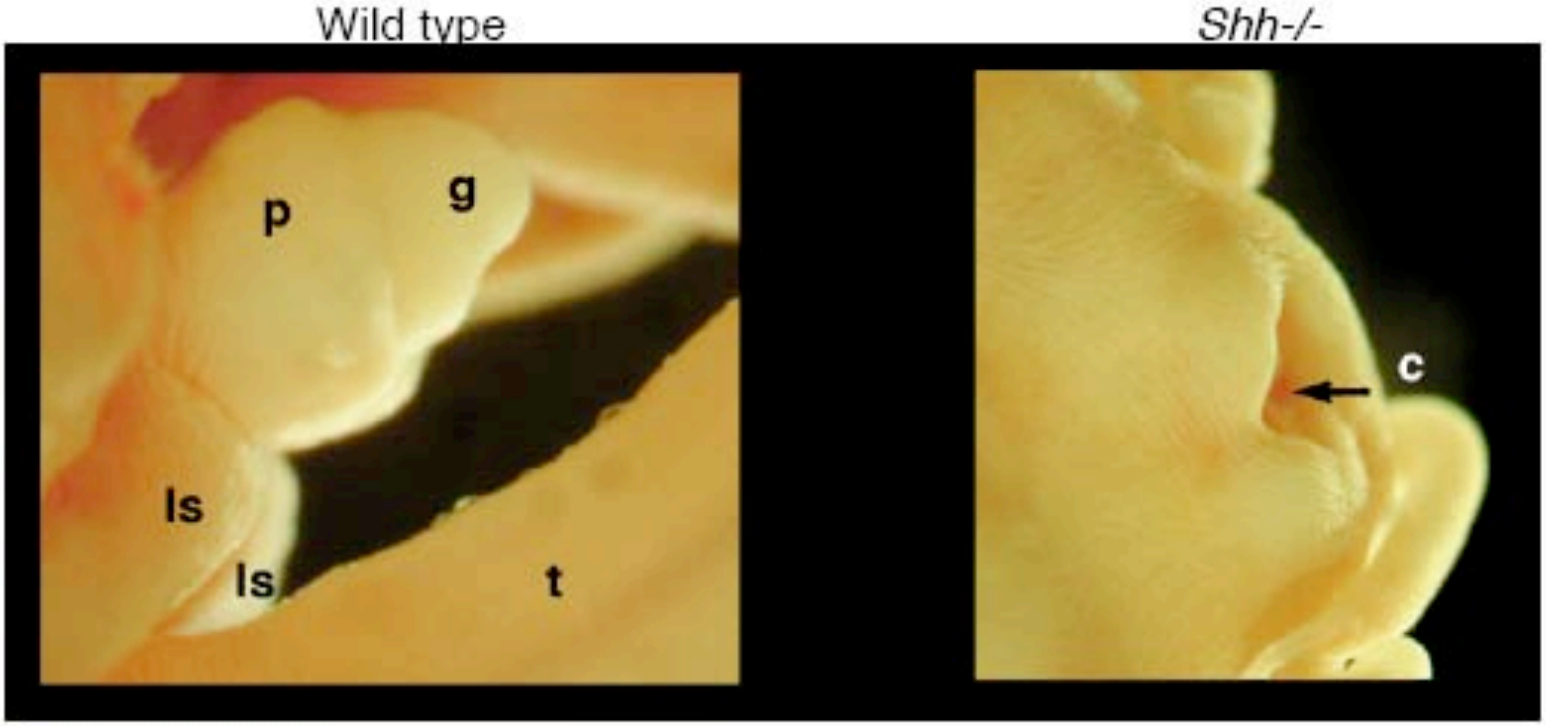

DNA microarray making
Microscope glass slides coated with polylysine
+
6116 Yeast ORFs amplified by PCR
Spotting (deposit)
Hybridisation
Strain 1
Strain 2
RNA extraction
Cy3
mRNA reverse transcription
Cy5
Results delivery
Scanning (lecture)
LASER
PMT
Results analysis
Stéphane Le Crom ENS 2003



Transgenic Animals



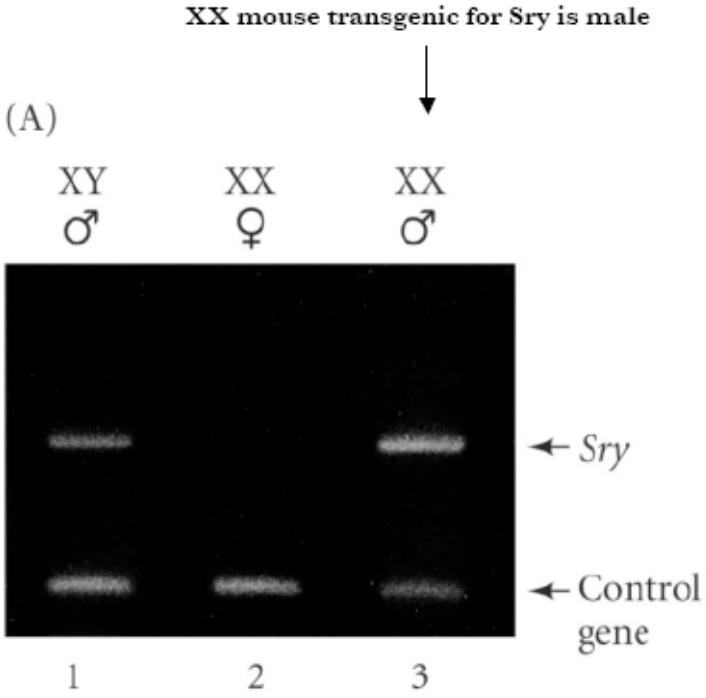
Shh-/- mice lack external genitalia



E.16.5

Dr. Marty Cohn

Gain of Function: Knock in SRY



(B)

Transfected female pronuclei with 14kb region from Y chromosome

Dr. Marty Cohn