Environmental Health: From Genomics to Analytical Chemistry

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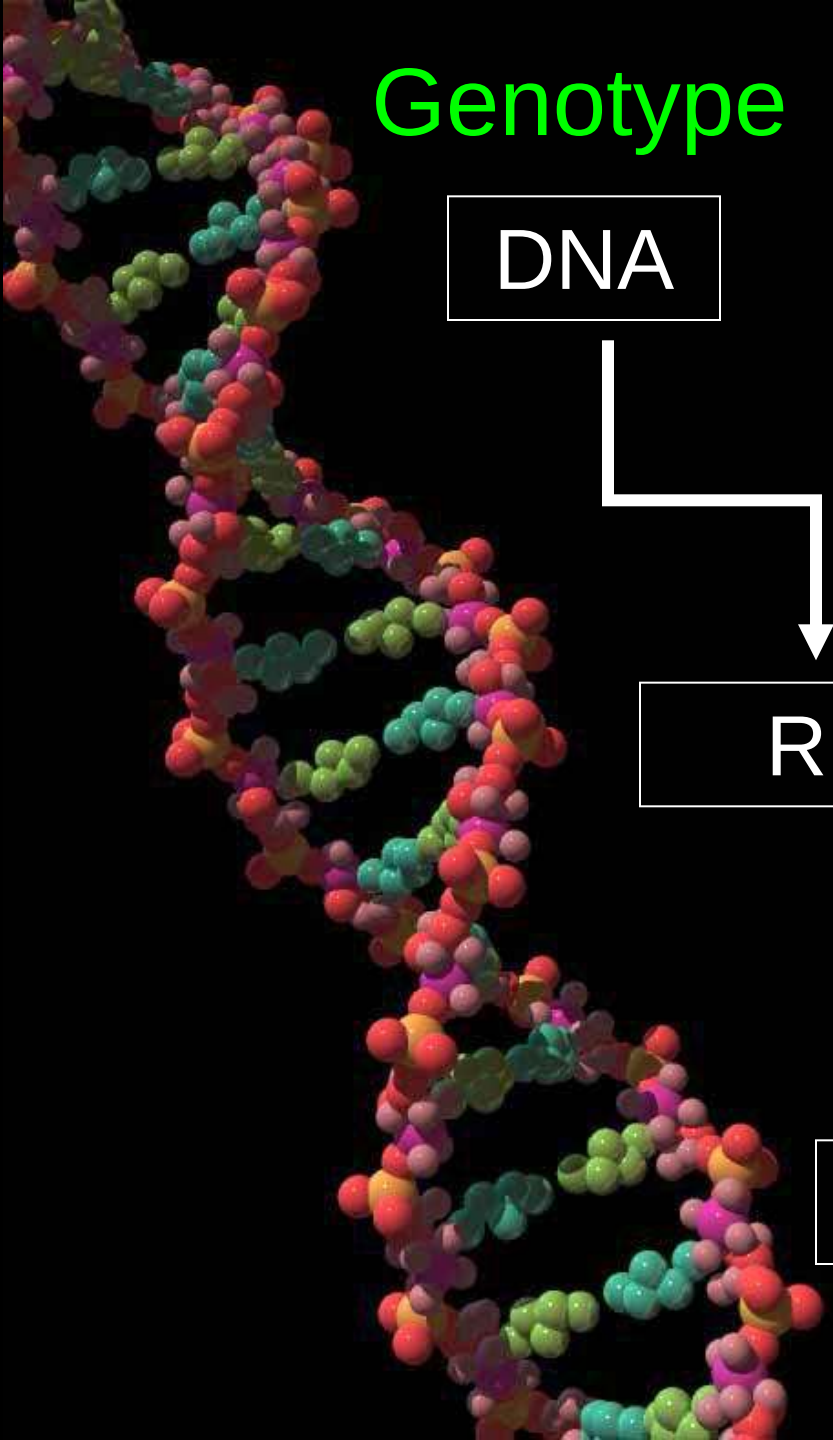
Genotype

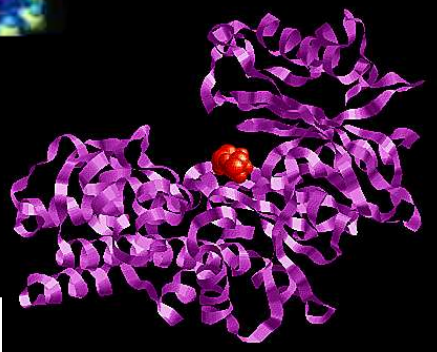
Genetic Determinism

DNA

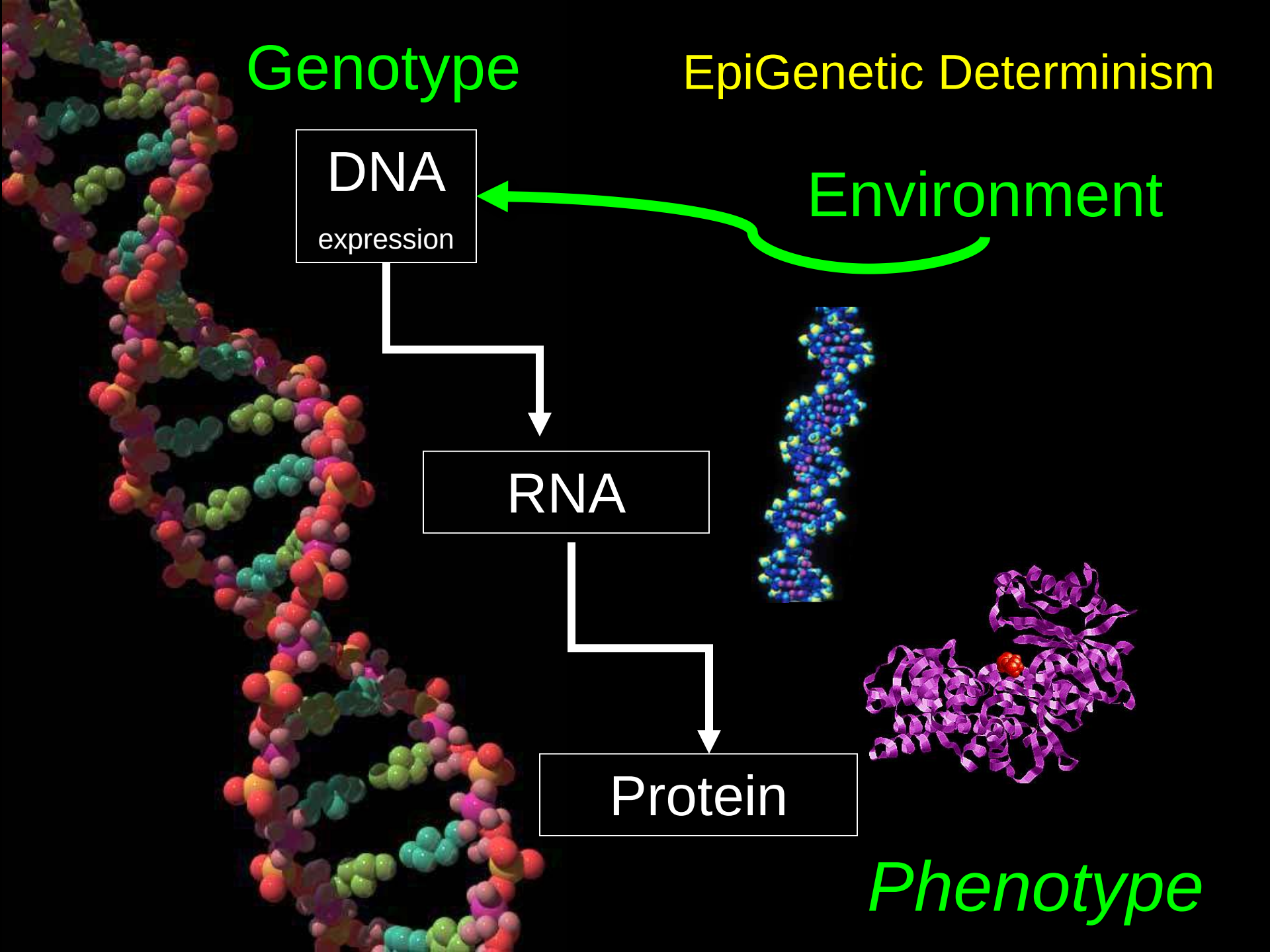


RNA

Protein



Phenotype


Genotype
EpiGenetic Determinism
DNA
expression
Environment
RNA
Protein
Phenotype

Health or Disease

Diet
Nutrients & Contaminants
(pesticides, metals, plasticizers, phytoestrogens)

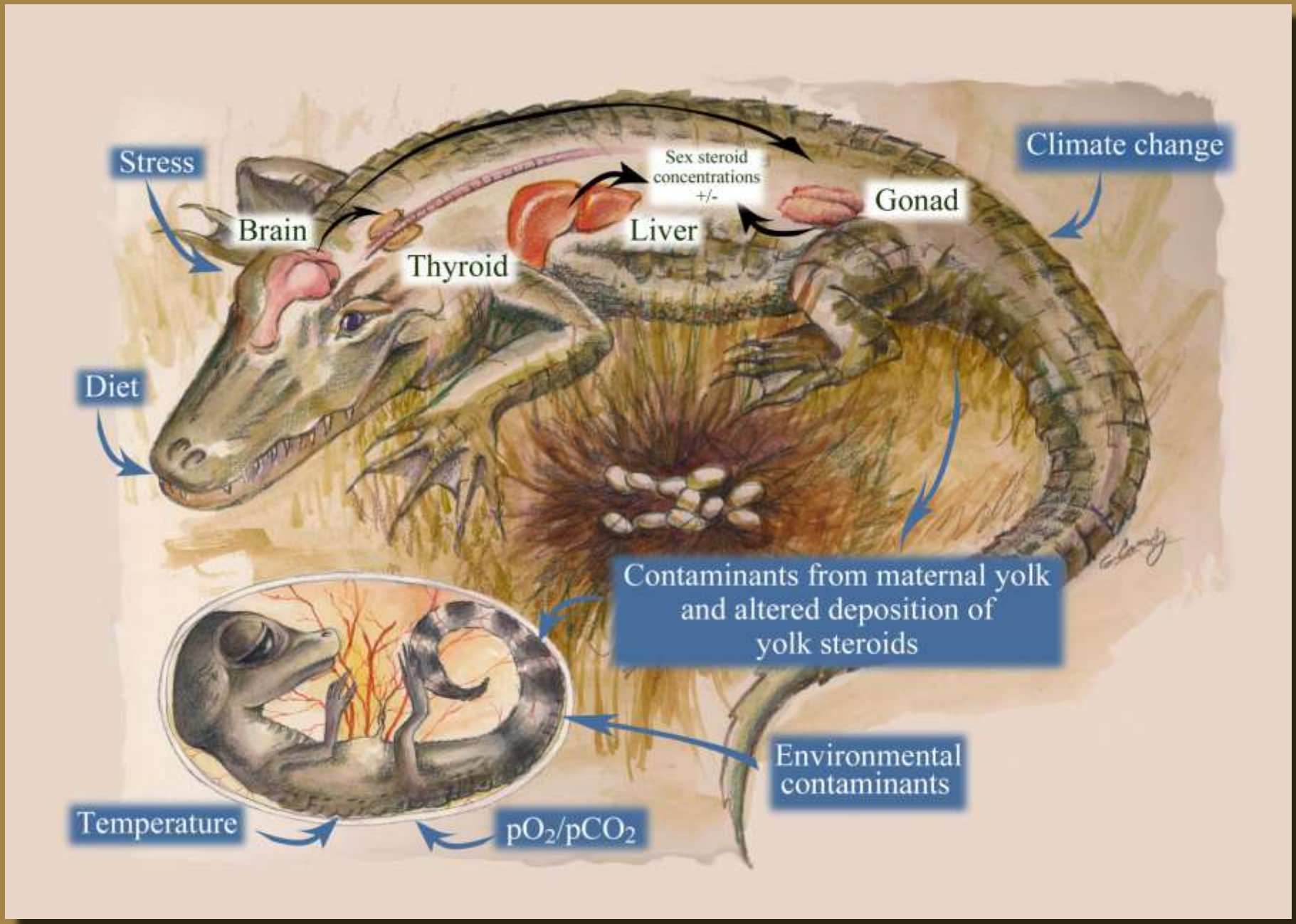
Drugs & Supplements
Legal & Illegal
(smoking, alcohol, vitamins)

Personal Care Products
(phthalates, musk xylene)

Stress
Behavioral & Environmental

Body Burden
Stored Contaminants – Fat & Bone

Genetics
Parental Genetics & Epigenetics



From Hamlin & Guillette, 2011, Embryo Today

Sentinel Species

'Watch and Warn'

- Powerful for studying environmental X gene perturbations
- Weak for some mechanistic studies

Environmental Factors

Abiotic Factors

Nutrition

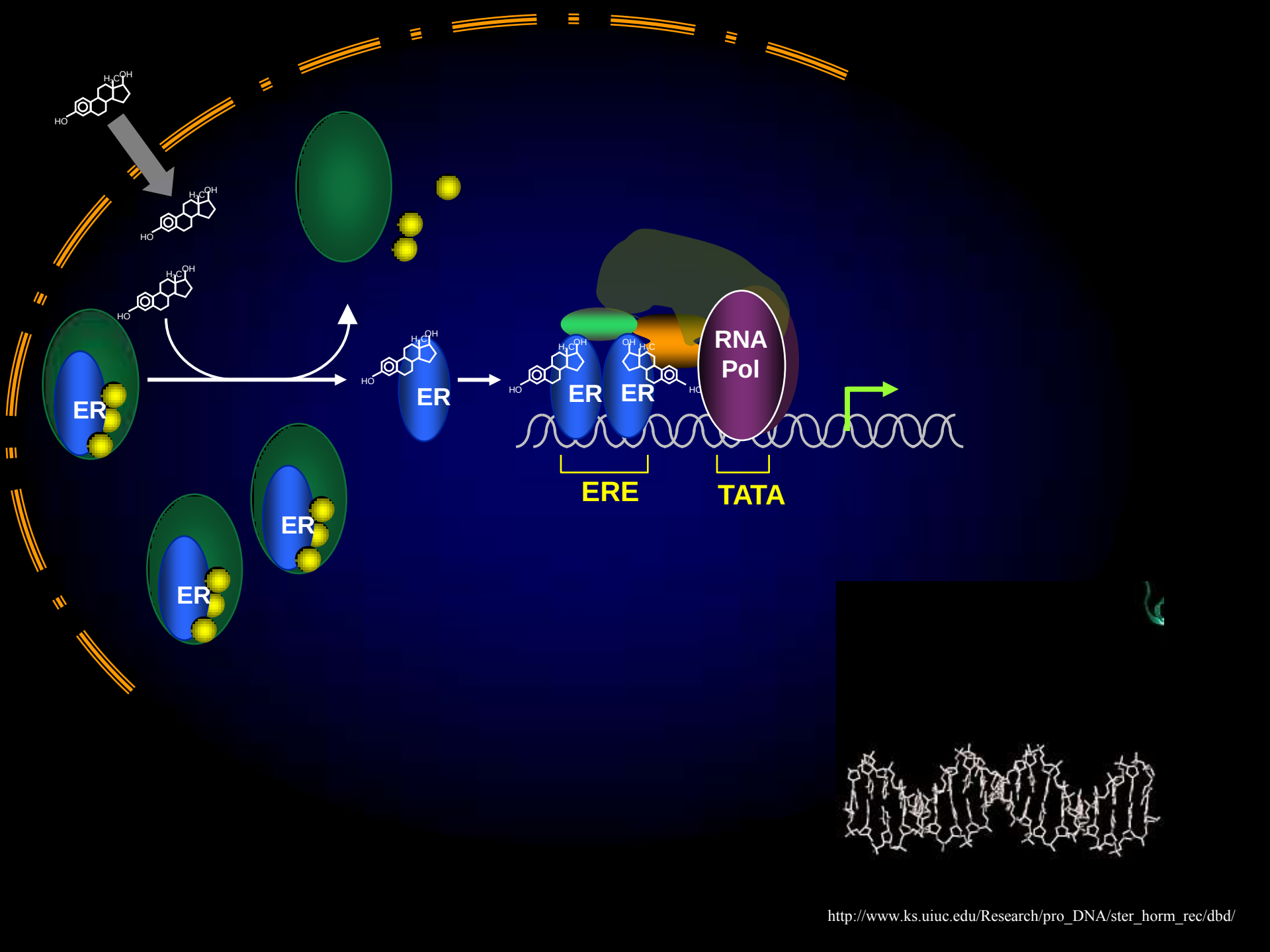
Xenobiotic Chemicals

- Signaling Disruption
  - Endocrine
  - Nervous
  - Immune

Environmental Factors

Steroid Signaling	Thyroid Signaling	Obsogenic Signaling

- Altered fertility & embryonic development
- Altered metabolism & energy utilization
- Altered fat storage and functioning

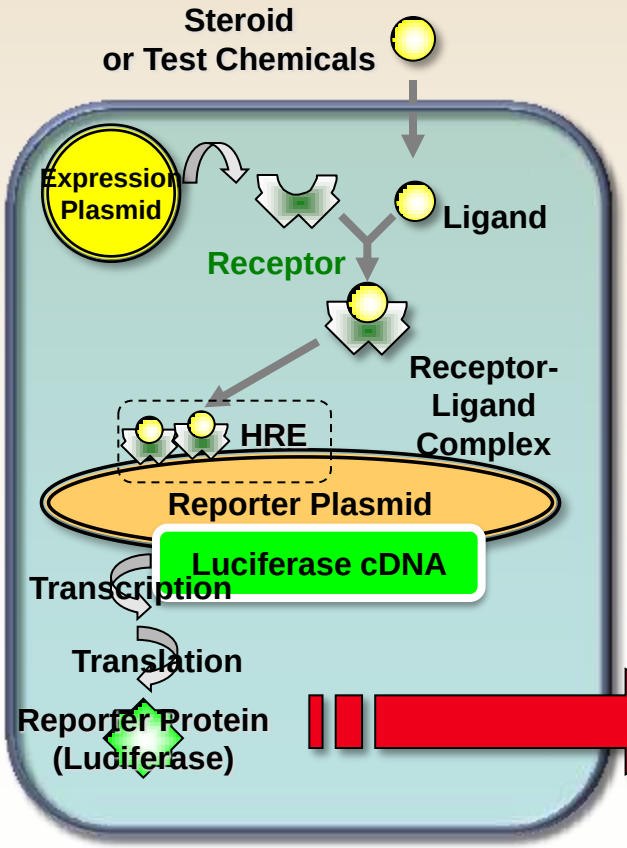


http://www.ks.uiuc.edu/Research/pro_DNA/ster_horm_rec/dbd/

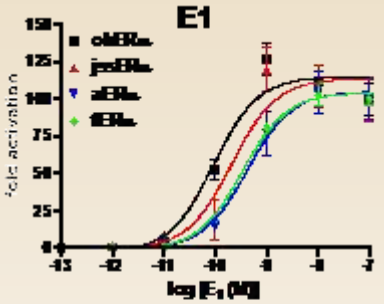
Transactivation assays with steroid hormone receptors

Kohno et al. (2008) Integ. Comp. Biology 48:527-534

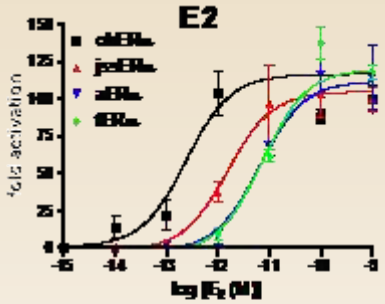
HRE-Luciferase System



estrogen response element-thymidine kinase-luciferase consensus palindromic ERE



Viper>Snake>Alligator=Turtle



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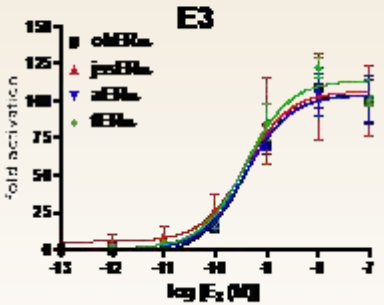
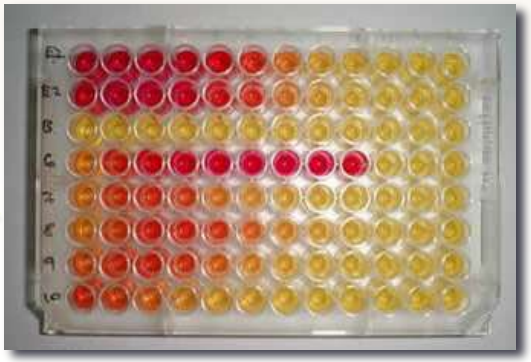


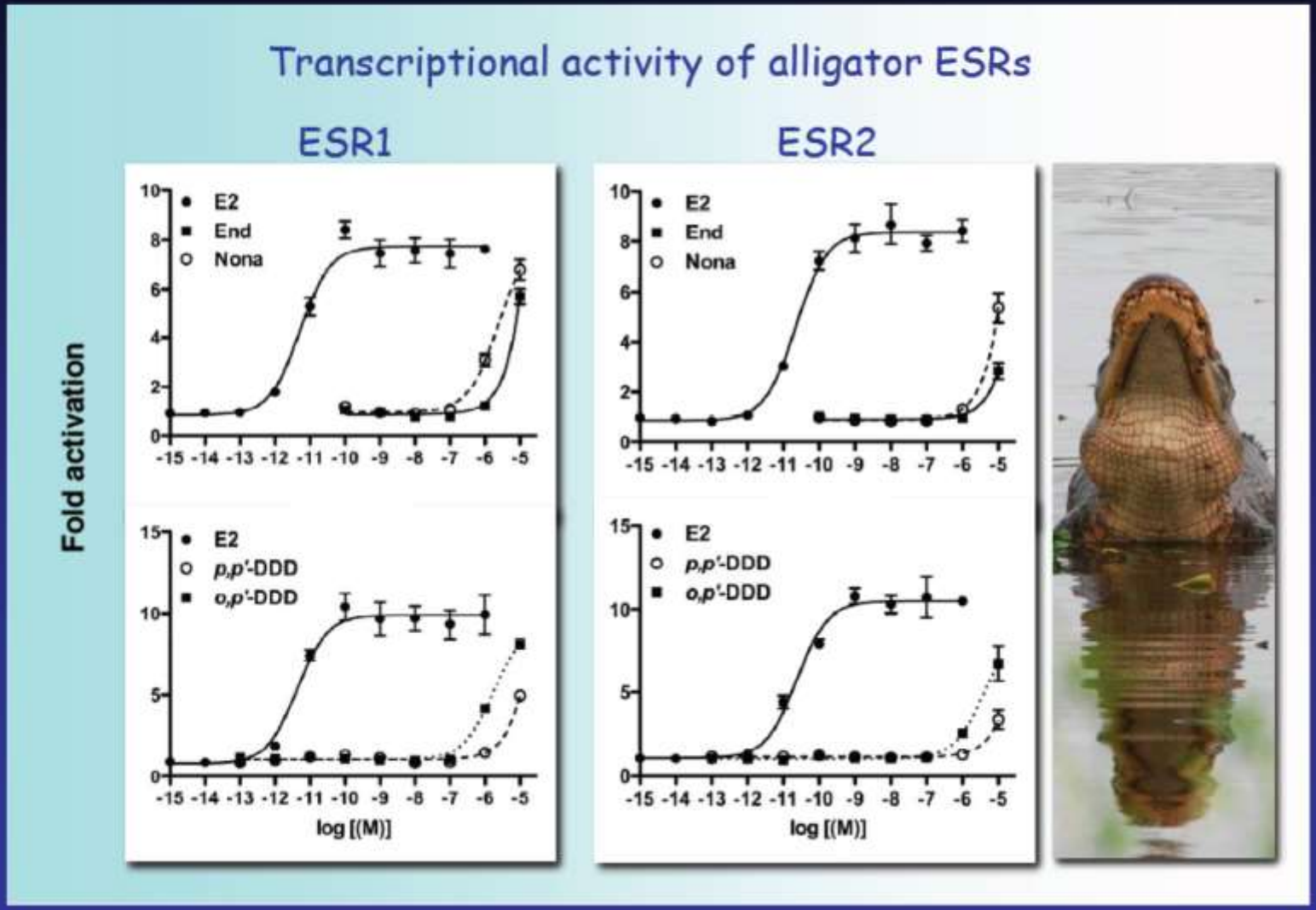
All Equal

olt: *Trimeresurus flavoviridis* (habu viper)
jss: *Elaphe quadrivirgata* (rat snake)
a: *Alligator mississippiensis* (alligator)
t: *Pseudemys nelsoni* (red-belly turtle)

Luminescence

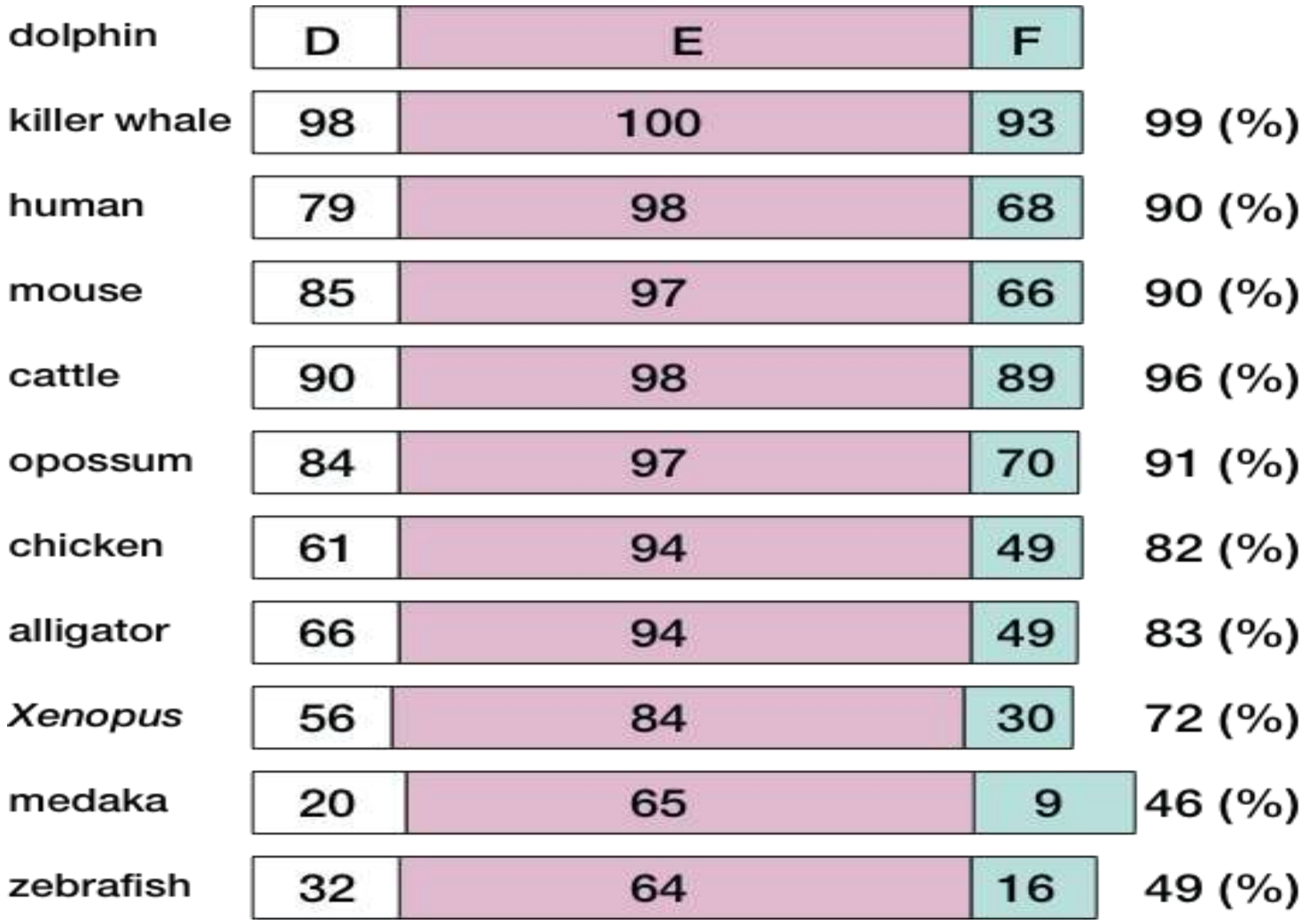


Estradiol, Endosulfan and *trans*-Nonachlor



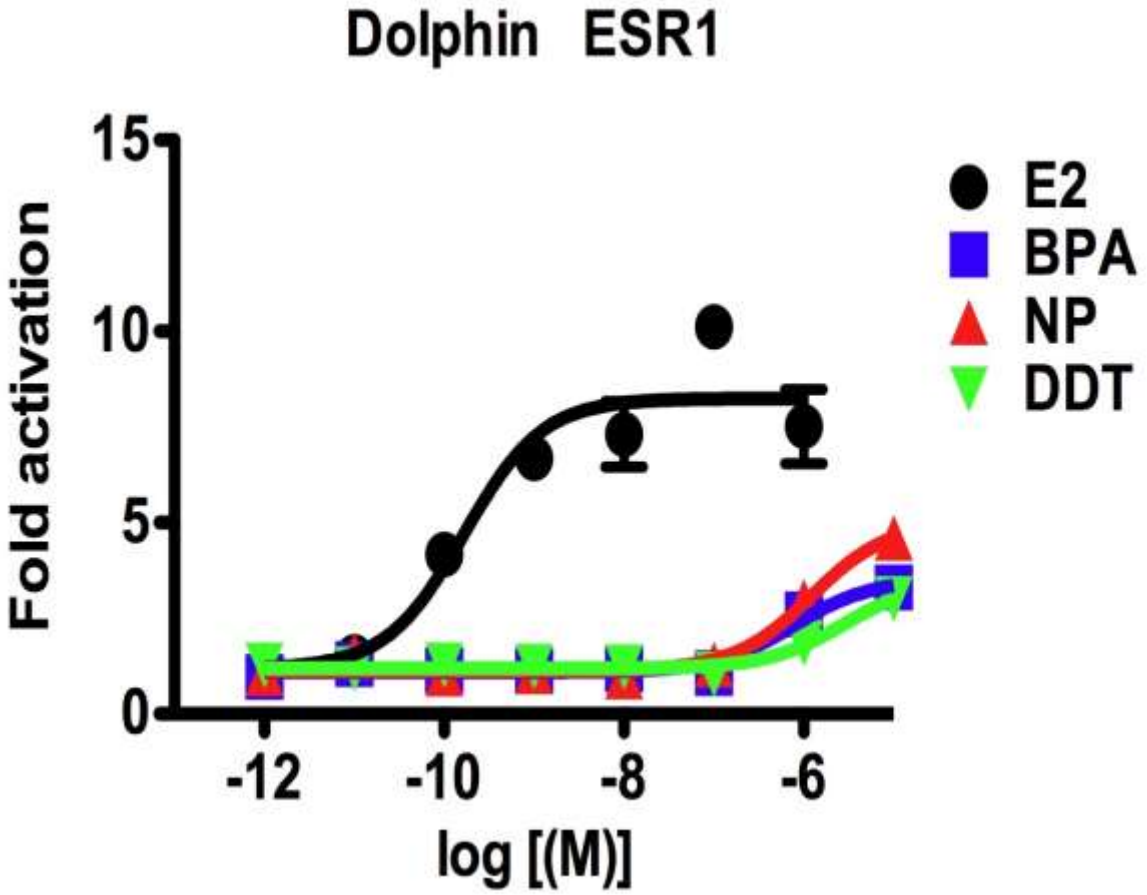
ERα Ligand Domain Sequence Similarity

Bottlenose Dolphin vs other vertebrates



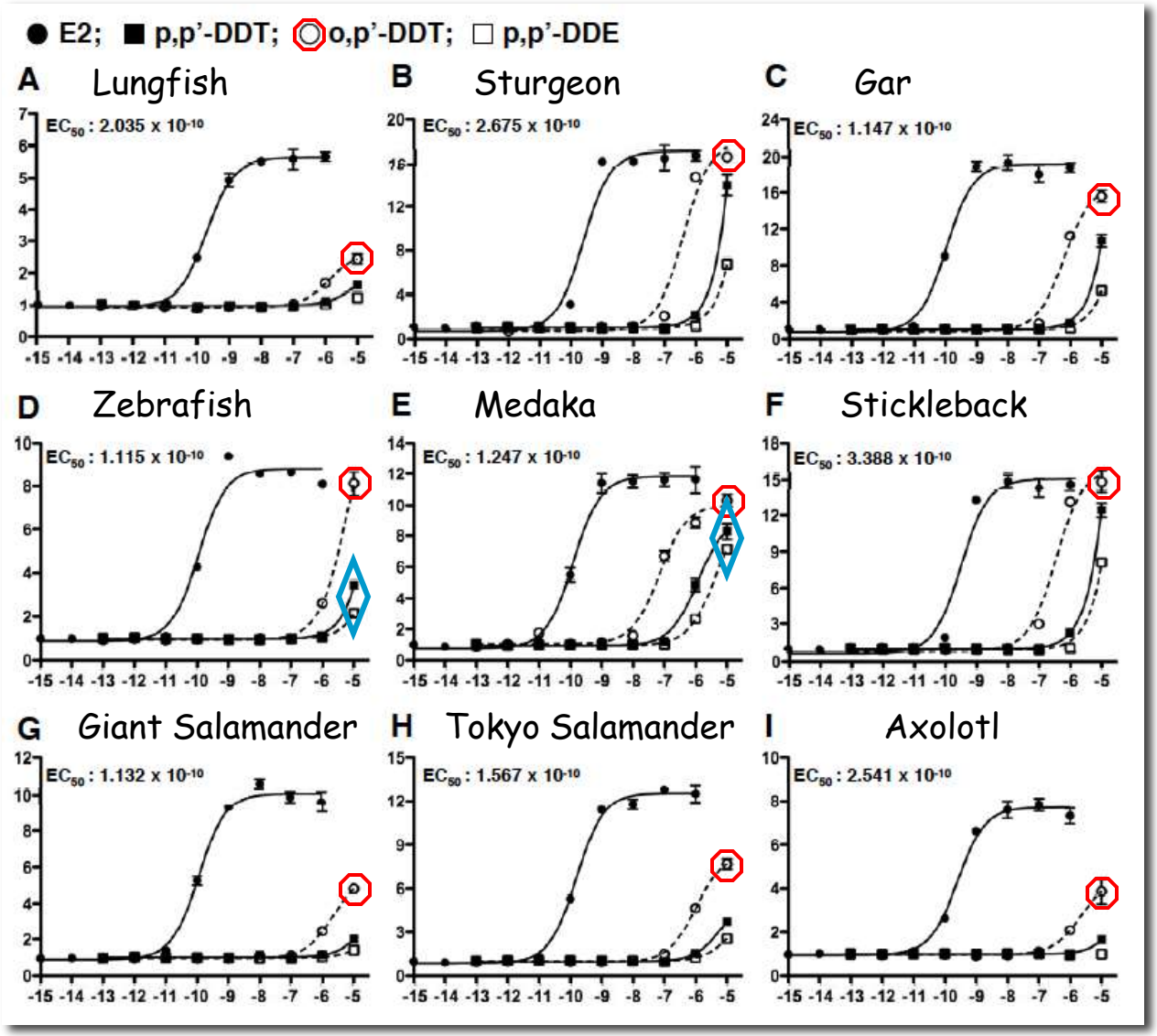
Iguchi & Guillette, unpubl. data

In vitro Transactivation Assay



Iguchi & Guillette, unpubl. data

ESR1 (ERα) and Contaminants

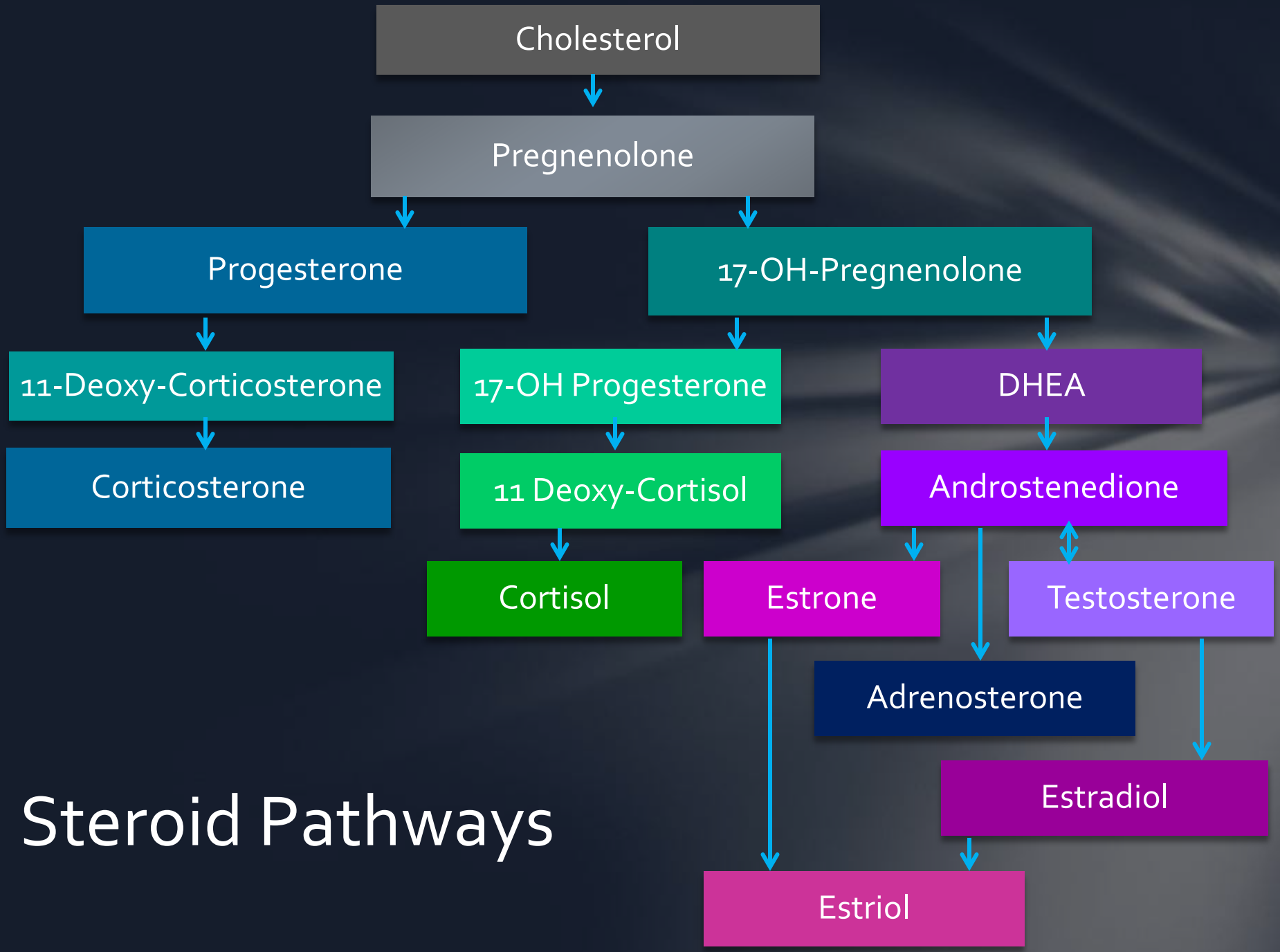


Katsu et al. Mol Cell Endo 2006, 2007; Endocrinology 2008a,b

Using Liquid Chromatography Tandem Mass Spectrometry for Hormone Analyses

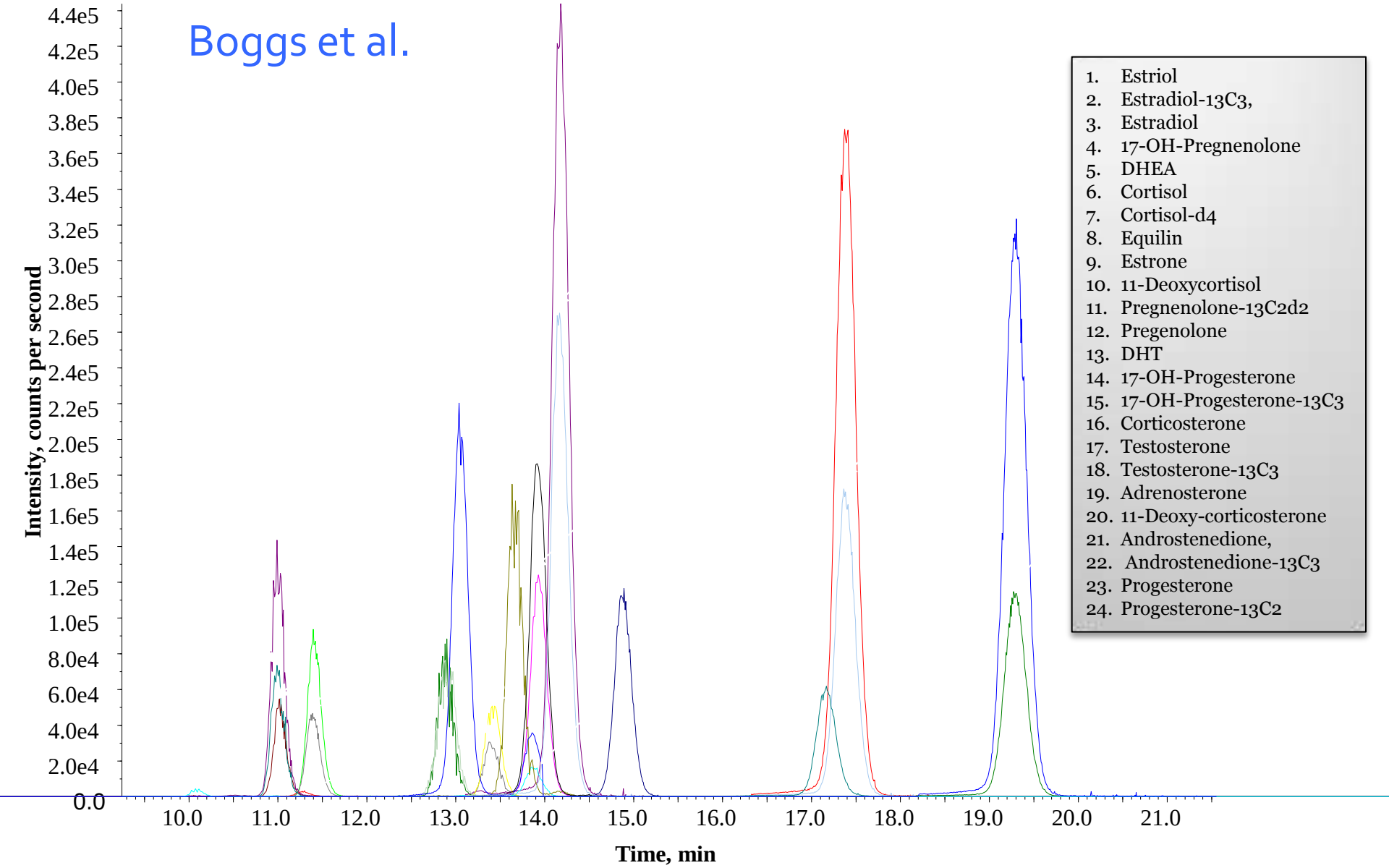
Ashley Boggs et al. (NIST, NOAA & MUSC)

- Uses retention times and fragmentation to detect hormones
- Allows DIRECT detection of hormones
  - Applicable to all vertebrate wildlife species
- Multiple hormones
  - single sample

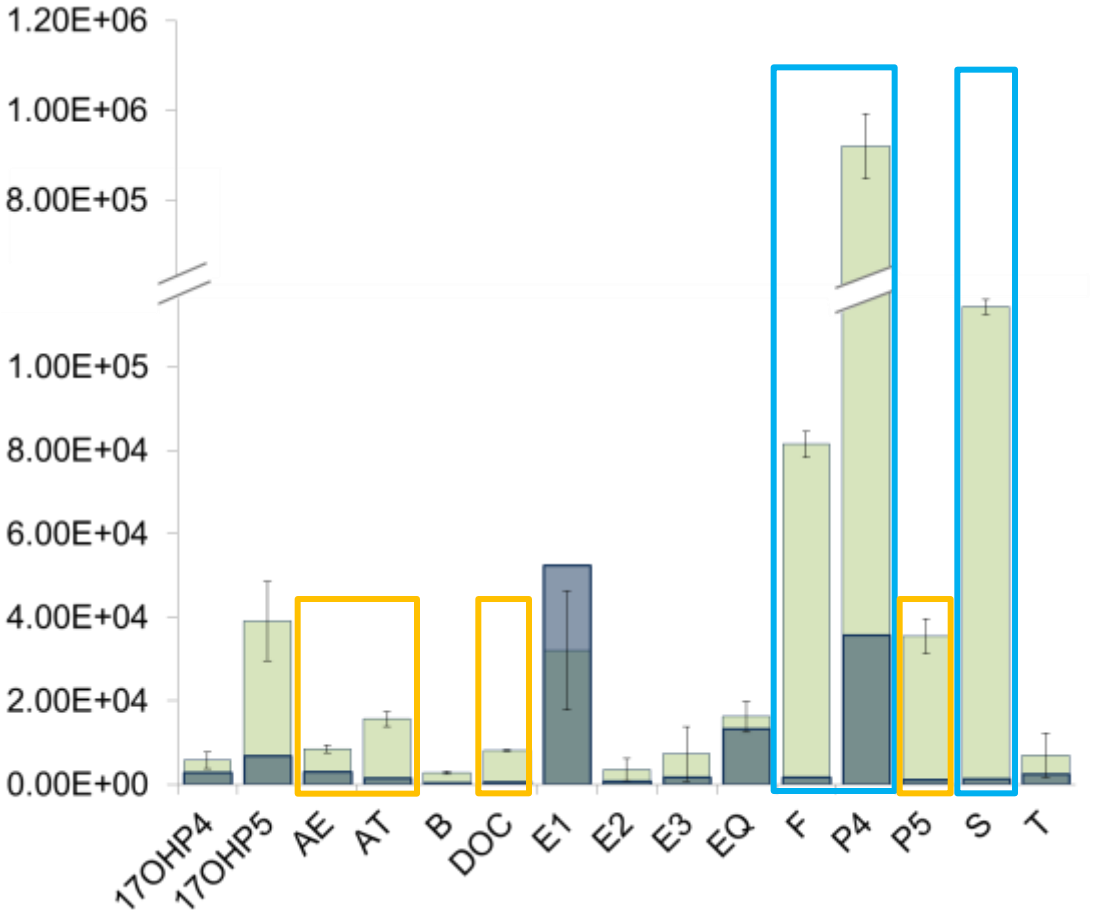


Steroid Pathways

Steroid Hormone Profile from a Single Sample



Female Pilot Whale Blubber



- Definite Targets
  Defined peak & RSD < 15%
  - Progesterone (P4)
  - Cortisol (F)
  - 11-Deoxy-Cortisol (S)
- Probable Targets
  Above LOD & RSD < 20%
  - Androstenedione (AE)
  - Adrenosterone (AT)
  - 11-Deoxy-Corticosterone (DOC)
  - Pregnenolone (P5)

Boggs et al.

HOLLINGS MARINE LABORATORY

MUSC
MEDICAL UNIVERSITY OF SOUTH CAROLINA

NOAA

NIST