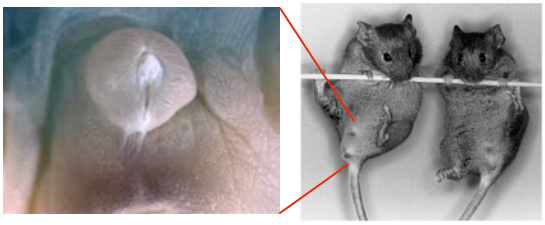
External Genitalia: Development and Evolution

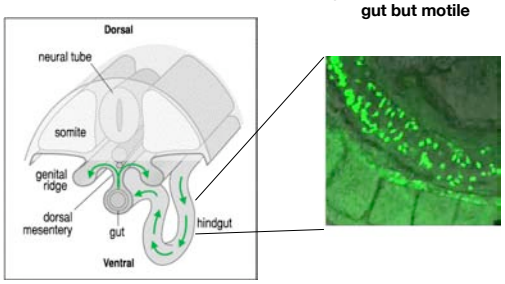


ZOO 4926 Biol. of Reproduction
Ashley W. Seifert

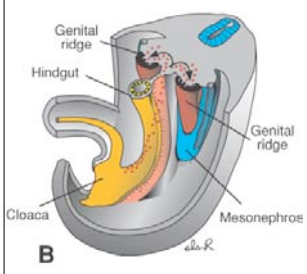
From fertilization to birth, mice develop in ~21 days. Each day is referred to as an embryonic day (E).

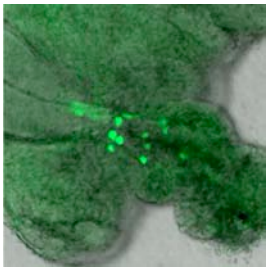
Here we see stages E9.5 through till birth

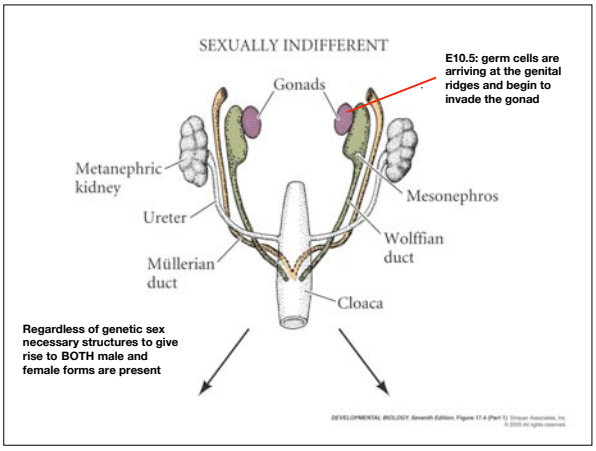
E9.0 germ cells confined to the gut but motile

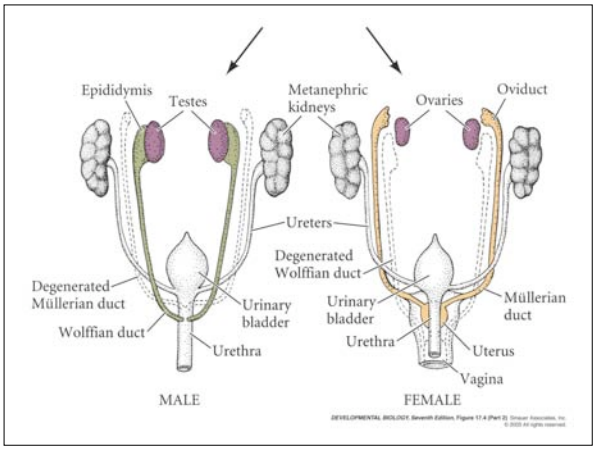


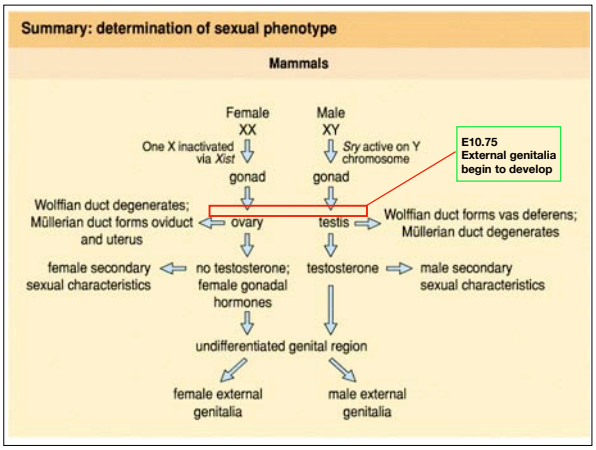
E9.5 Emerge from the gut and move towards the genital ridges

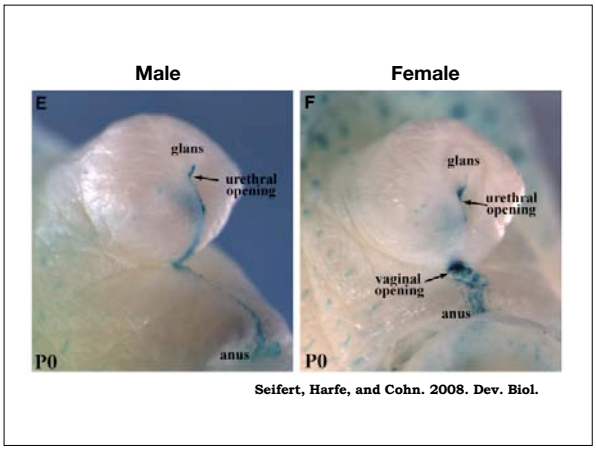








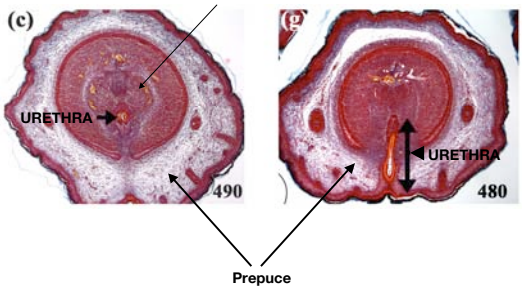




Seifert, Harfe, and Cohn. 2008. Dev. Biol.

Male Female

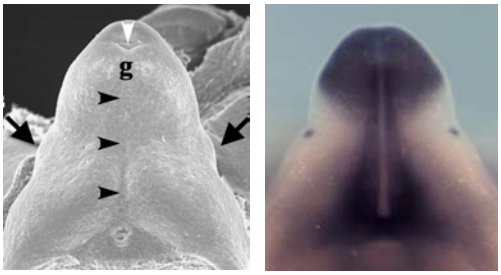
corporal bodies



Prepuce

Developmental Biology

Embryological Anatomy + Molecular Genetics

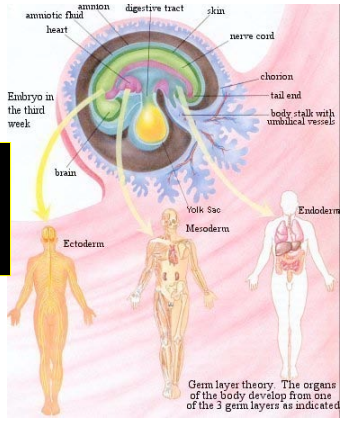


Morphogenesis = the differentiation and growth of a structure

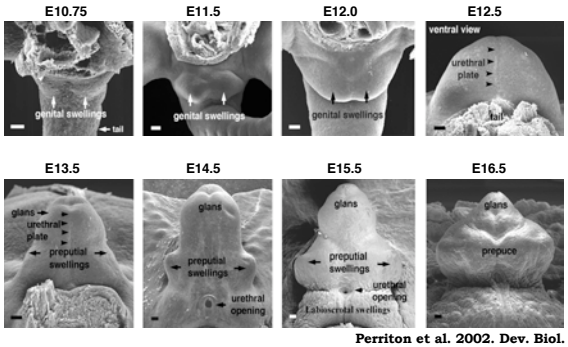
Ectoderm: preputial glands, skin

Mesoderm: erectile & connective tissue, smooth muscle, cartilage, bone

Endoderm: urethra



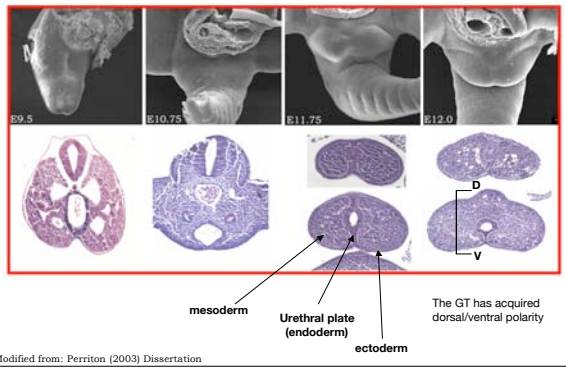
Scanning electron micrographs of the mouse Genital tubercle (GT)



Perriton et al. 2002. Dev. Biol.

Scale bar = 80 μm

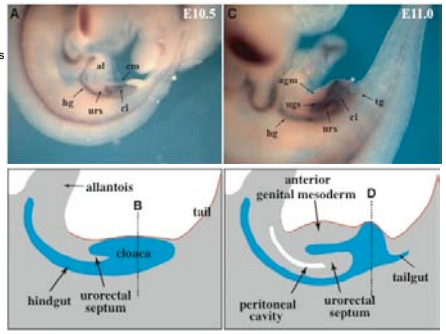
The GT is comprised of all 3 germ layers



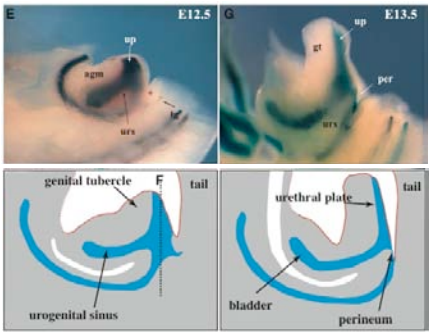
The GT has acquired dorsal/ventral polarity

Modified from: Perriton (2003) Dissertation

The primitive **cloaca** progressively becomes divided into the future anal and urinary openings

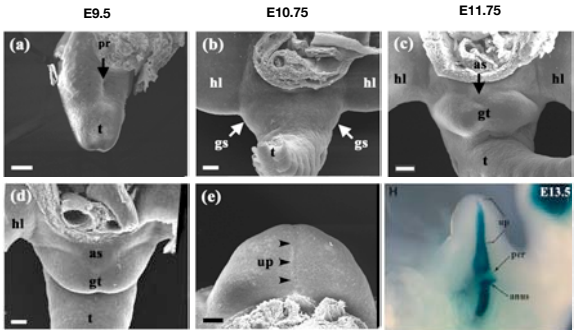


Seifert, Harfe, and Cohn. 2008. Dev. Biol.



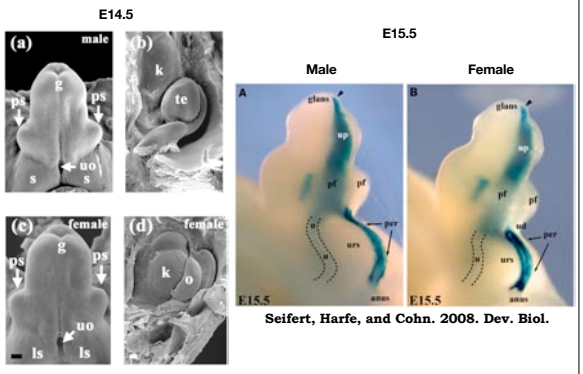
The first phase of GT development is complete with formation of the perineum

Seifert, Harfe, and Cohn. 2008. Dev. Biol.



Modified from: Perriton (2003) Dissertation

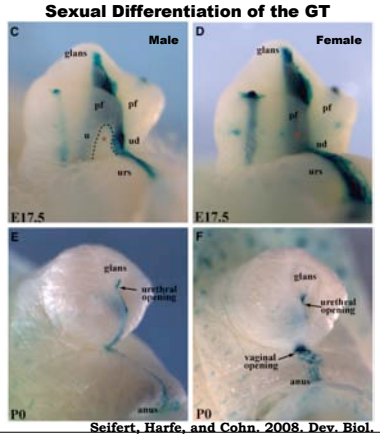
Sexual Differentiation of the GT



Seifert, Harfe, and Cohn. 2008. Dev. Biol.

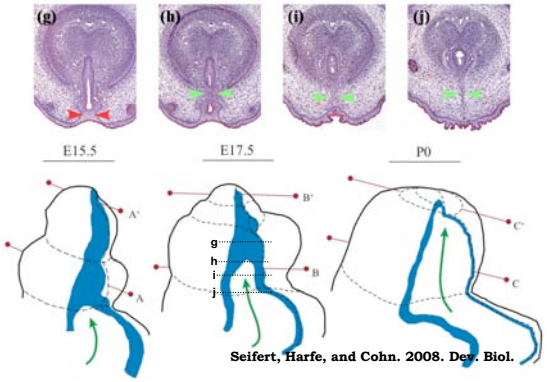
Modified from: Perriton (2003) Dissertation

Sexual Differentiation of the GT

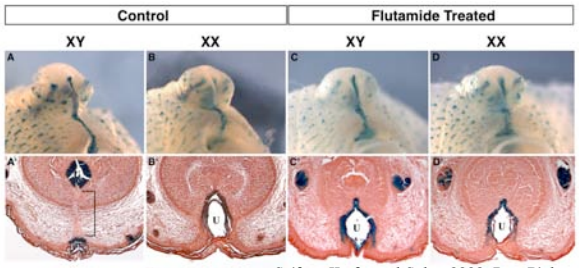


Seifert, Harfe, and Cohn. 2008. Dev. Biol.

Androgen signaling drives masculinization

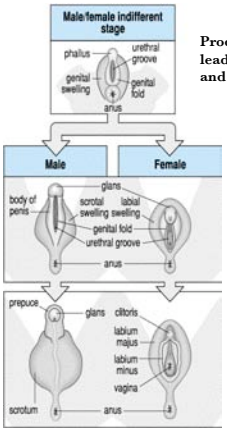


Seifert, Harfe, and Cohn. 2008. Dev. Biol.



Seifert, Harfe, and Cohn. 2008. Dev. Biol.

Androgen insensitivity (AIS) leads to feminization of XY individual



Production of testosterone leads to male maturation and formation of the penis

What molecular mechanisms induce the development of external genitalia?

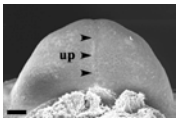
Genes and their protein products are the language of cells

M. J. Cohn

The developmental program must generate:

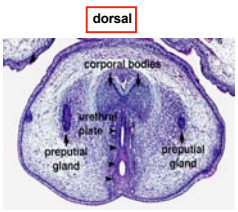
(1) outgrowth

DISTAL



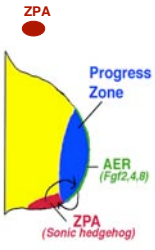
PROXIMAL

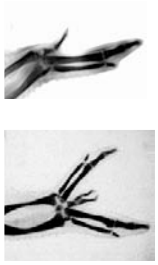
(2) Polarity and Pattern

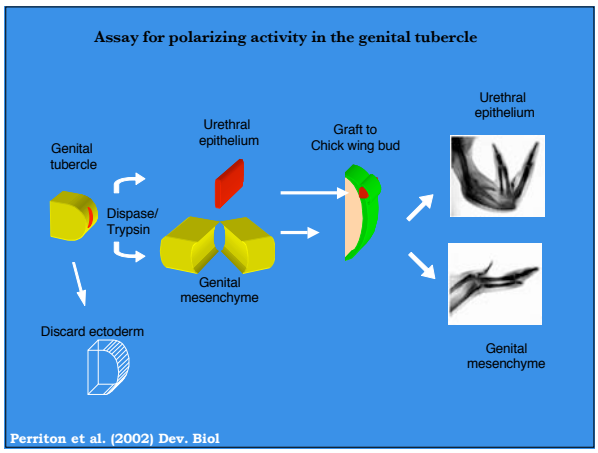


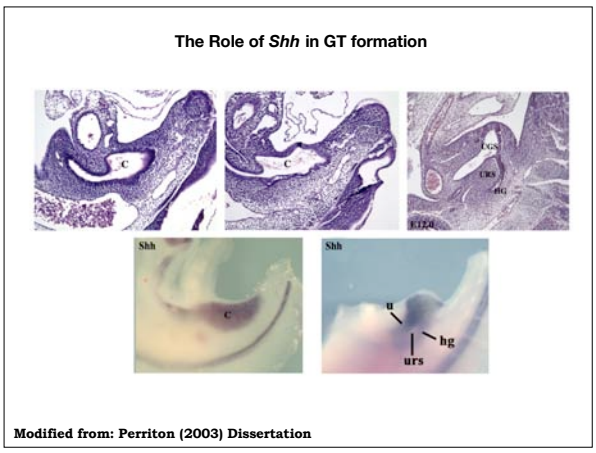
Modified from: Perriton (2003) Dissertation

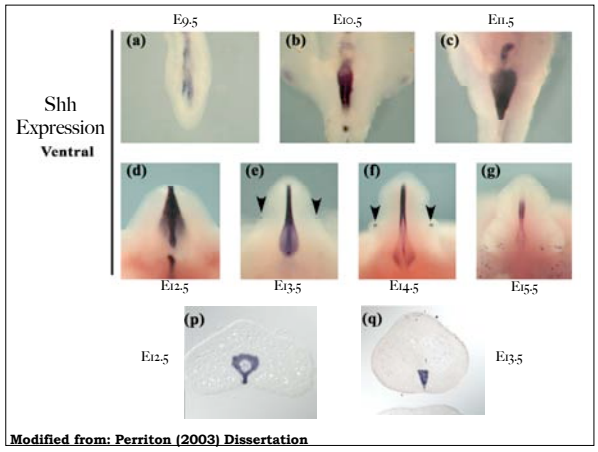
The zone of polarizing activity (zpa) patterns the a-p axis of vertebrate limbs





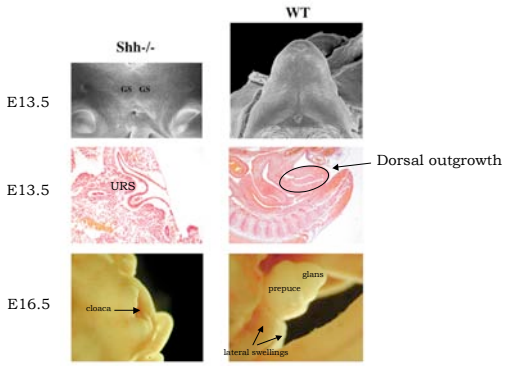

Assay for polarizing activity in the genital tubercle
Genital tubercle
Dispase/ Trypsin
Urethral epithelium
Genital mesenchyme
Discard ectoderm
Graft to Chick wing bud
Urethral epithelium
Genital mesenchyme
Perriton et al. (2002) Dev. Biol


The Role of Shh in GT formation
Shh
Shh
u
hg
urs
Modified from: Perriton (2003) Dissertation


E9.5
E10.5
E11.5
Shh Expression
Ventral
(a)
(b)
(c)
(d)
(e)
(f)
(g)
E12.5
E13.5
E14.5
E15.5
(p)
(q)
E12.5
E13.5
Modified from: Perriton (2003) Dissertation

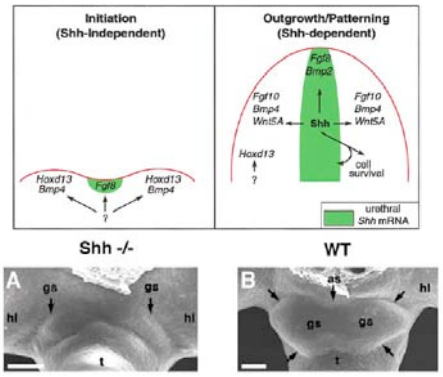

The Shh null has no external genitalia and a persistent cloaca
PENIS
PERINEUM
ANUS
A. W. Seifert
A. W. Seifert
WT
Shh-/-

The Role of Shh in GT formation



Modified from: Perriton et al. (2001) Developmental Biology

A necessary role for *Shh* during GT Development



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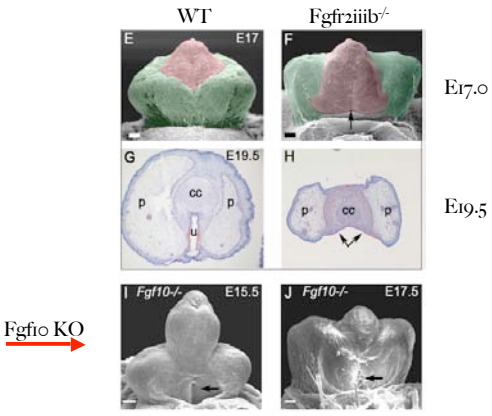
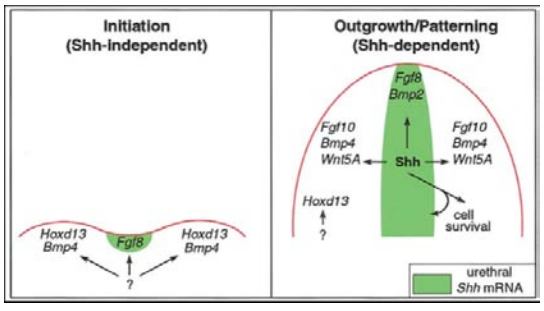


Petiot et al. (2005). Development 132 2441-2450



Modified from: Perriton et al. (2002) Developmental Biology

Evolution

Phenotypic Diversity in Morphological Structures