

# The Menstrual Cycle

Reproductive and Developmental Biology

October 2011  
Mandy Donaldson

---

---

---

---

---

---

---

---

## The Menstrual Cycle

### Learning Objectives

To understand the involvement of the following in the regulation of the menstrual cycle.

- HPG Axis
- Two cell two gonadotrophin hypothesis
- Steroidogenesis
- Dominant follicle
- Inhibin

---

---

---

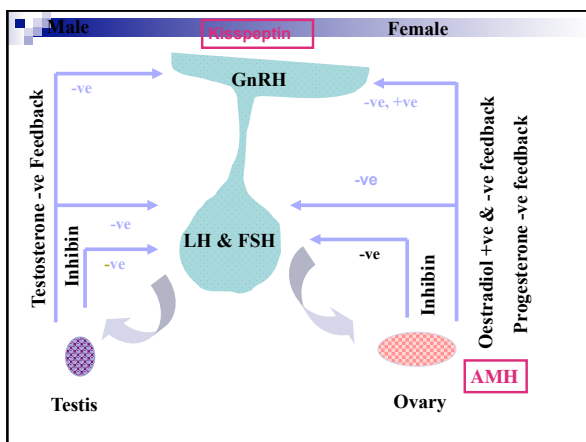
---

---

---

---

---



---

---

---

---

---

---

---

---

## Kisspeptin and Kisspeptin Receptors

- Natural ligands for orphan G protein coupled receptor GPCR -GPR54 (rats) and AXOR 12 (humans)
- Kisspeptin & GPR54 mRNA localized in brainstem, hypothalamus, pituitary, spinal chord, ovary, prostate and placenta
- Mutations in the receptor result in ideopathic hypogonadotrphic hypogonadism
- Kisspeptins are major neuroendocrine regulators of reproduction regulators of reproduction

---

---

---

---

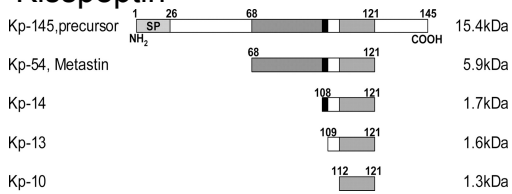
---

---

---

---

## Kisspeptin



- KiSS-1 gene first described in 1996 as a metastasis suppressing gene
- Located on chromosome 32 giving rise to a 145 amino acid precursor which is cleaved into 54 amino acid lengths
- Further cleavage forms 14, 13 and 10 amino acid fragments
- Kp-10 minimal length for activation of the KP receptor

---

---

---

---

---

---

---

---



---

---

---

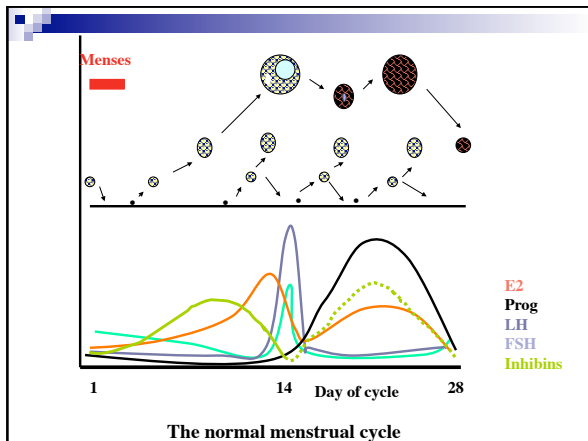
---

---

---

---

---




---

---

---

---

---

---

---

---

---

---

### The growth of follicles

time	<-340 to -190 days	-70 days	-45 days	-25 days	-10 days	day 1	day 5	day 14			
class	primordial	primary	pre-antral class 1	early antral class 2	class 3	class 4	class 5	recruitment	selection	dominance	pre-ovulatory class 8
diameter	0.06mm	0.12mm	0.2mm	0.4mm	0.9mm	2mm	5mm	10mm	16mm	20mm	
number of granulosa cells	..	6 × 10 <sup>3</sup>	3-5 × 10 <sup>4</sup>	1.5 × 10 <sup>4</sup>	7.5 × 10 <sup>4</sup>	3.7 × 10 <sup>5</sup>	1.9 × 10 <sup>6</sup>	9.4 × 10 <sup>6</sup>	4.7 × 10 <sup>7</sup>	6.0 × 10 <sup>7</sup>	
1 layer epitheloid cells in theca											
atresia		24%	35%	15%	24%	58%	77%	50%			

---

---

---

---

---

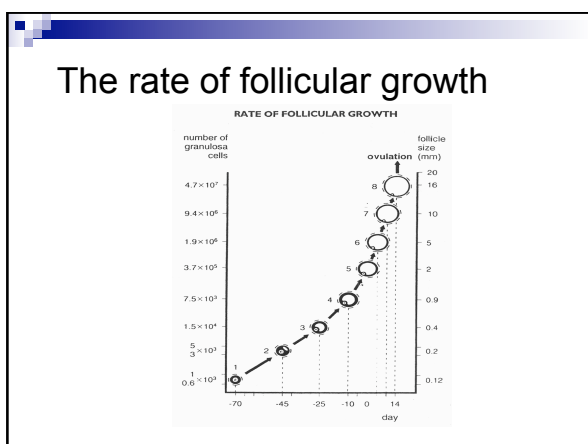
---

---

---

---

---




---

---

---

---

---

---

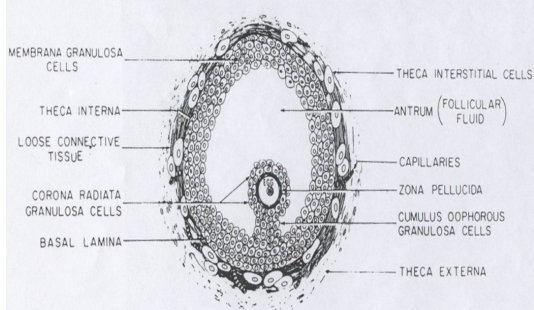
---

---

---

---

# The Graffian Follicle




---

---

---

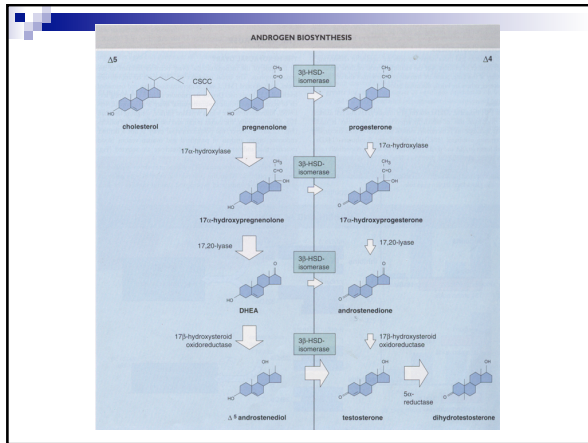
---

---

---

---

---




---

---

---

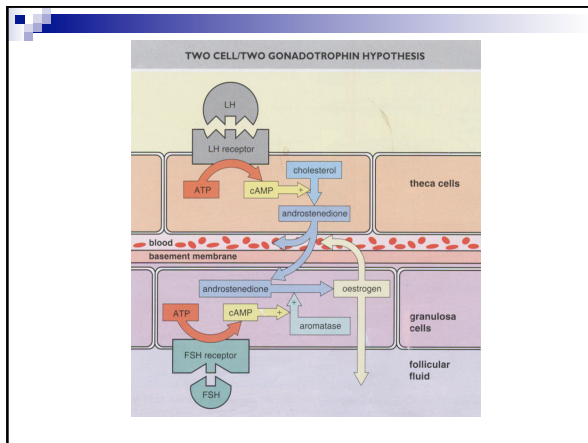
---

---

---

---

---




---

---

---

---

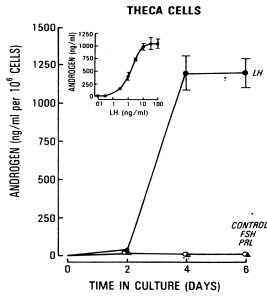
---

---

---

---

## Androgens in culture




---

---

---

---

---

---

---

---

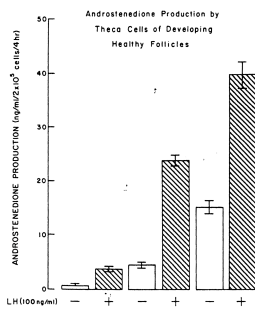
---

---

---

---

## Androstenedione Production




---

---

---

---

---

---

---

---

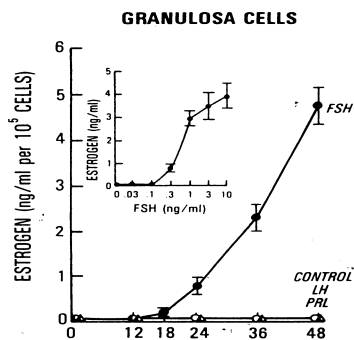
---

---

---

---

## Oestrogen production in Granulosa cells




---

---

---

---

---

---

---

---

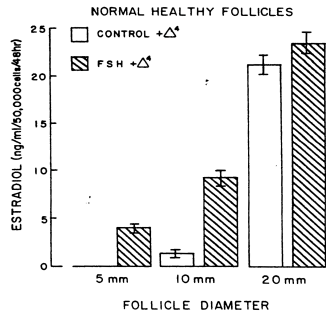
---

---

---

---

## Oestrogens and Follicular size




---

---

---

---

---

---

---

---

## Kisspeptin in the adult

- GnRH neurons only possess the oestrogen receptor  $\beta$  which does not play a role in feedback mechanisms
- Kisspeptin neurons have receptors for androgens, progesterone and oestradiol
- Animal experiments have shown that regulation of Kiss-1 expression is likely to be a mediator of negative feedback but precise mechanism in primates is not known
- In rodents negative feedback is via the arcuate nucleus and positive feedback is via the anterior paraventricular nucleus
- Same mechanism not true in sheep or primates - only the arcuate nucleus appears to be involved

---

---

---

---

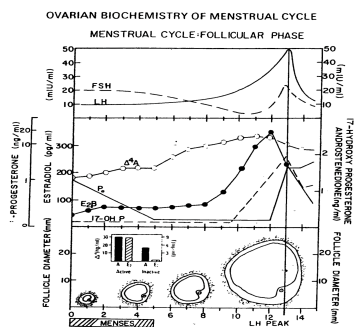
---

---

---

---

## The biochemistry of the Menstrual cycle




---

---

---

---

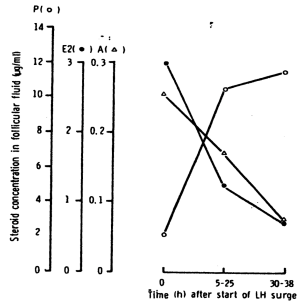
---

---

---

---

### The steroids in follicular fluid in relation to the LH surge




---

---

---

---

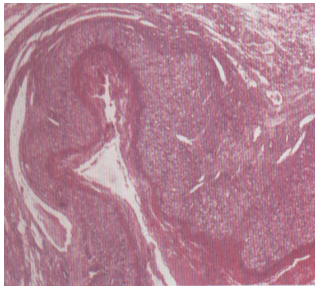
---

---

---

---

### Corpus luteum




---

---

---

---

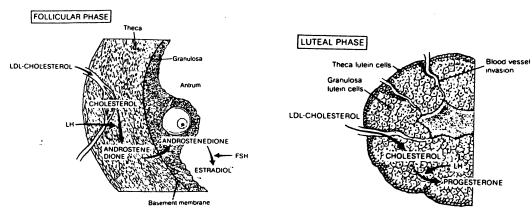
---

---

---

---

### Steroids in the Follicular and Luteal Phases




---

---

---

---

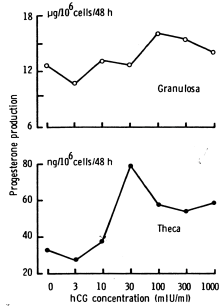
---

---

---

---

## Progesterone production




---

---

---

---

---

---

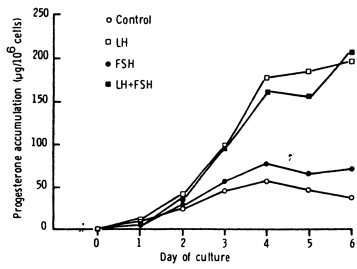
---

---

---

---

## Progesterone in culture




---

---

---

---

---

---

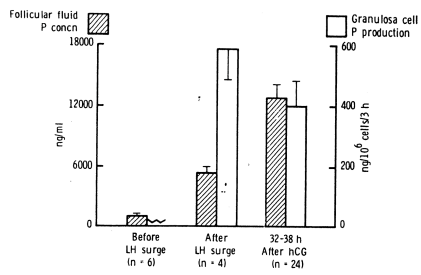
---

---

---

---

## Progesterone production in response to LH




---

---

---

---

---

---

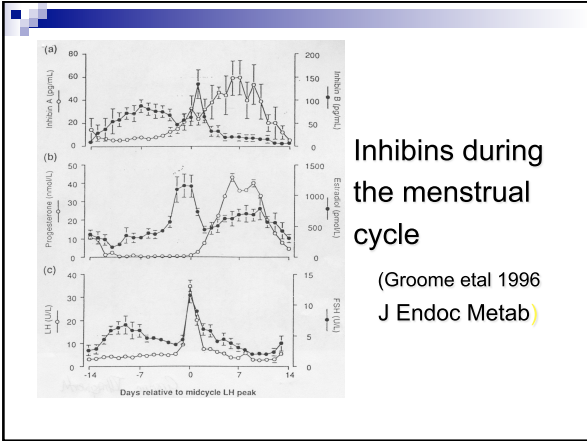
---

---

---

---






---

---

---

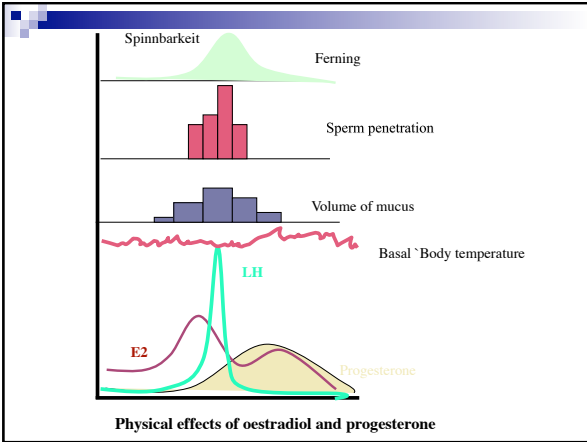
---

---

---

---

---




---

---

---

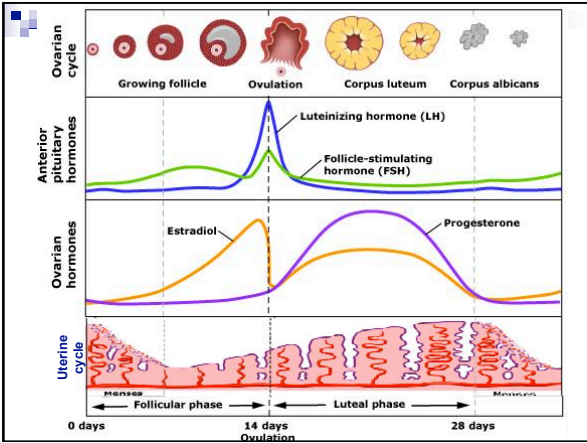
---

---

---

---

---




---

---

---

---

---

---

---

---