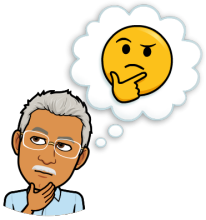
Animal Science 434
Reproductive Physiology

Puberty



1

Development of

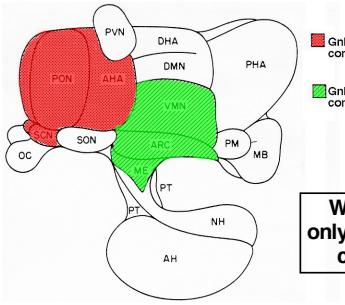
Hypothalamus and GnRH

Release Centers

Males and Females are Different!!!

2

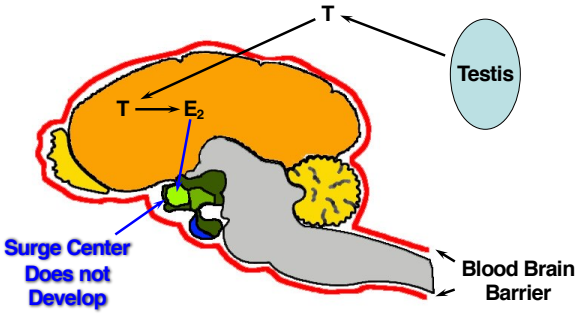
Hypothalamus GnRH Control Centers in the Female



Why does the male only have tonic control centers develop?

3

Male Brain Development



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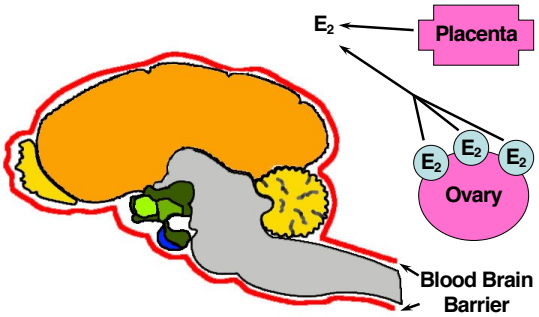
Female Brain Development



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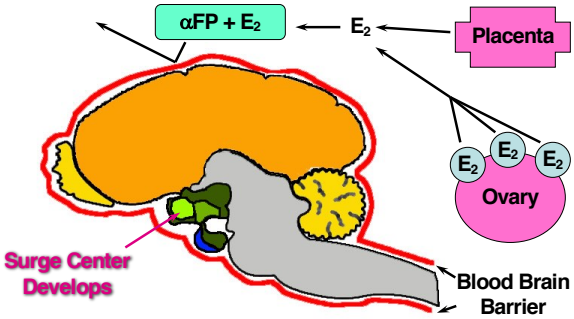
Female Brain Development



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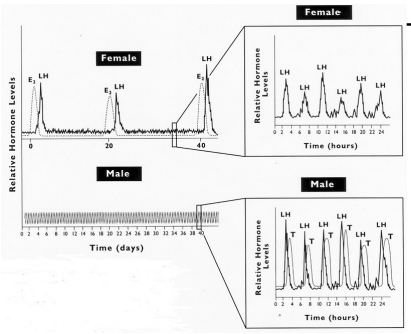
Fundamental Male and Female Differences

Pulse Patterns



Surge + Tonic

Tonic

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Puberty

- The ability to accomplish reproduction.
- Definitions in Male and Female
  - » See Textbook
- Age of Puberty
  - » See Textbook

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Quiz 8a

Why does the hypothalamus in the male not develop a surge center?

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Quiz 8a

Why does the hypothalamus in the male not develop a surge center?

Testosterone is secreted by the fetal testes and is converted to estrogen in the brain and then the estrogen prevents the surge center from development in the hypothalamus.

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Quiz 8a

In the female, estrogen is secreted by the placenta and ovary. That estrogen does not reach the brain due to binding to alpha fetal protein in the blood.

The surge center does not see estrogen and therefore <u>develops</u> in the female.

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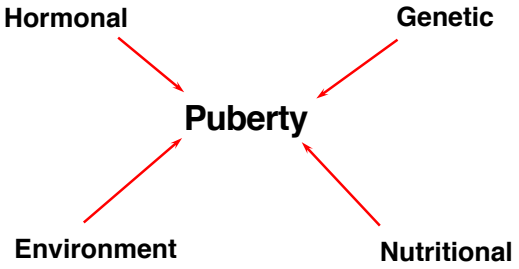

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Hormonal

Role of GnRH Pulses

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GnRH Pulses Determine Puberty

- Prepubertal period
  - » minimal GnRH release
  - » FSH and LH low
  - » minimal to no follicular genesis or spermatogenesis
- Puberty
  - » increase in the pulse frequency and amplitude of GnRH release
  - » increase in FSH and LH pulses
  - » follicular genesis and spermatogenesis occur

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Hormonal Changes in the Female

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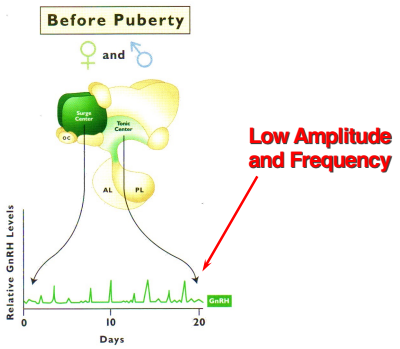
Hypothalamic Secretion of GnRH



Senger, 2012

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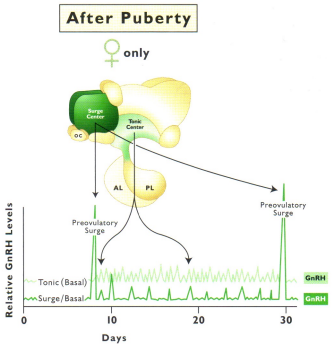
Hypothalamic Secretion of GnRH



Senger, 2012

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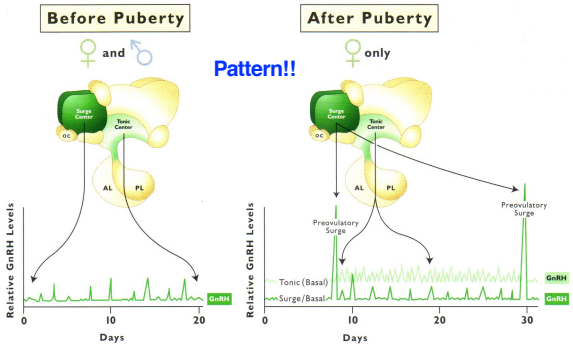
Hypothalamic Secretion of GnRH



Senger, 2012

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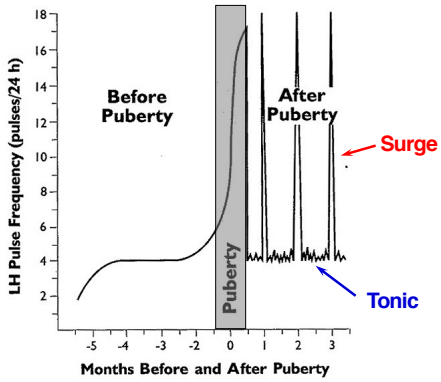

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Potential Regulators of GnRH Pulses at Puberty

- Development of surge center
- Change in the feedback sensitivity to estradiol

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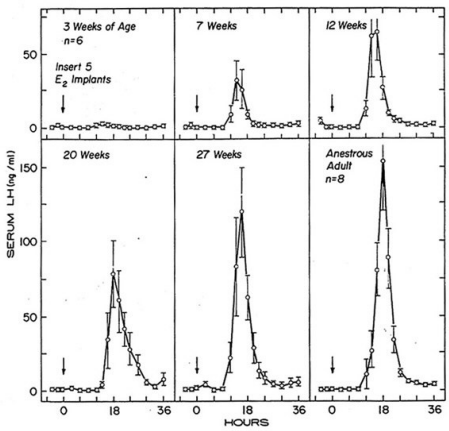
Development of the Hypothalamic GnRH Surge Center

Puberty = 28 - 30 weeks



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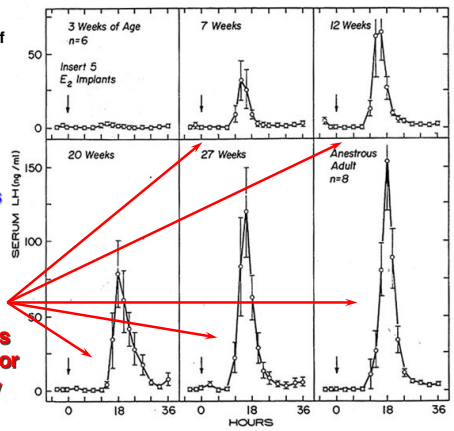
Development of the Hypothalamic GnRH Surge Center

Puberty = 28 - 30 weeks

Positive Feedback is possible prior to puberty



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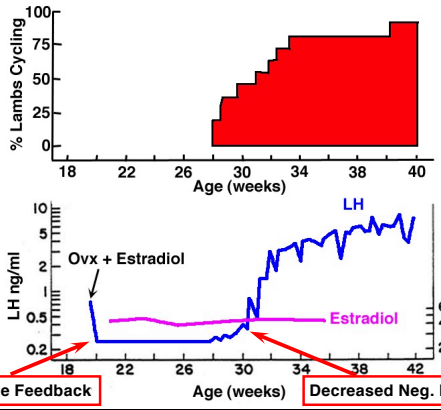
Changes in Feedback Sensitivity to Estradiol



Negative Feedback

Decreased Neg. Feedback

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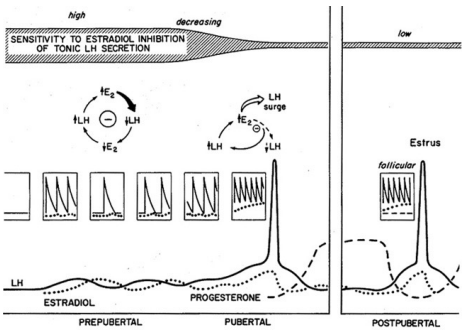
Puberty in the Female



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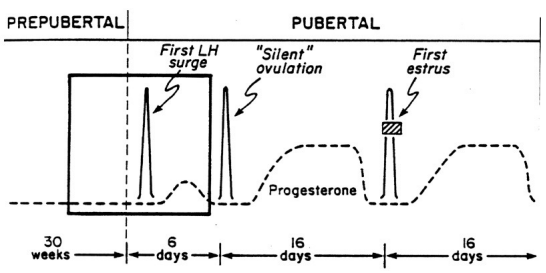
Silent Ovulation at Puberty



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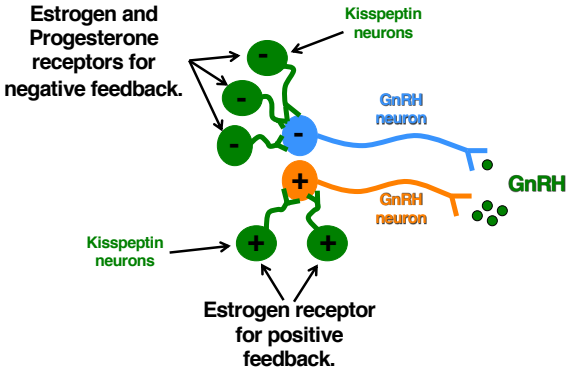
Steroid Hormone Influence on GnRH Neurons



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Hormonal Changes in the Male

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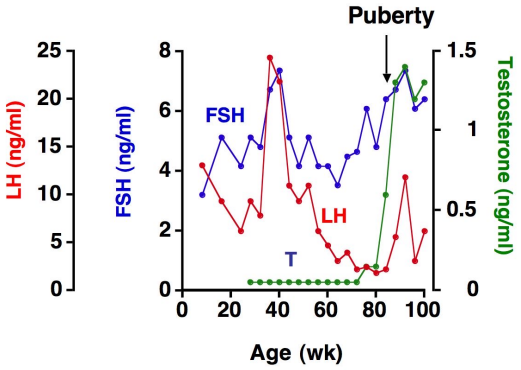
Puberty in the Stallion



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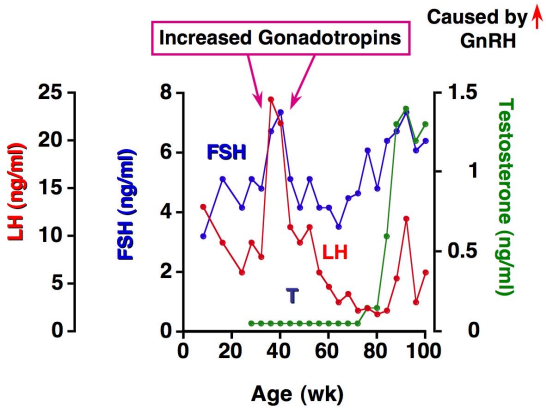

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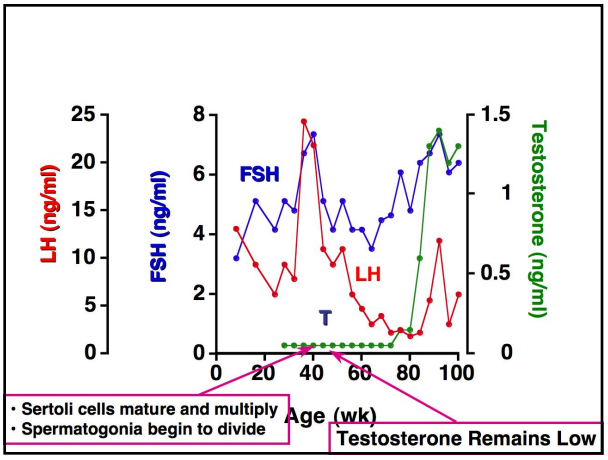

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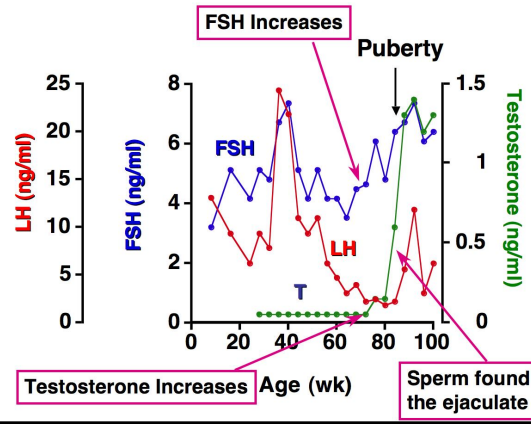

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Genetics

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Influence of Breed on Age of Puberty

Species	Average Age at Puberty (Months) Female	Male
Cattle		
Holstein	8.5	9.0
Brown Swiss	11.6	8.8
Angus	12.4	9.8
Hereford	13.0	10.8
Brahman	19.0	17.0
Swine		
Meishan	3.1	3.0
Large White	6.3	5.8
Yorkshire	7.0	6.5
Sheep		
Rambouillet	9.2	
Finish Landrace	8.6	

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Nutrition

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Availability of Energy Changes with Growth

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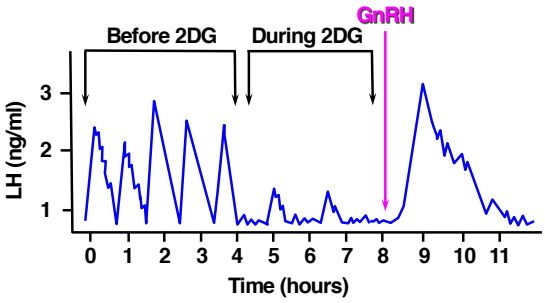
Effect of 2-deoxyglucose on LH Pulses



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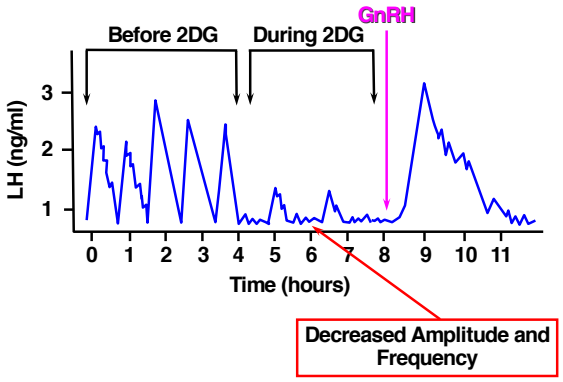
Effect of 2-deoxyglucose on LH Pulses



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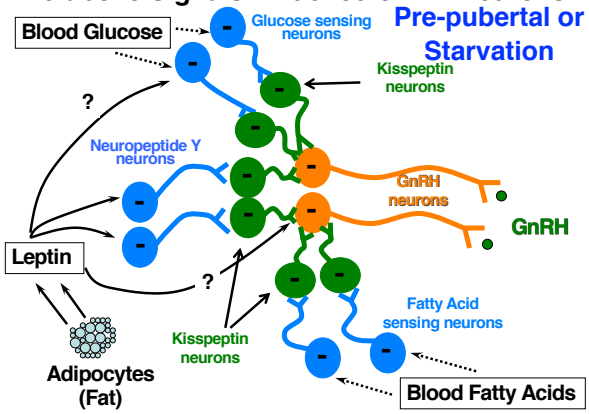
Metabolic Signals Influence GnRH Neurons



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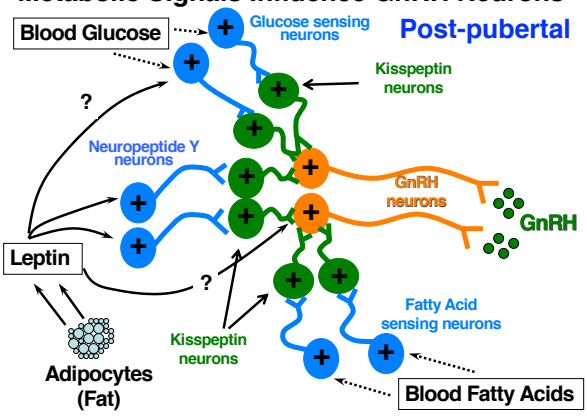
Metabolic Signals Influence GnRH Neurons



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Question 4b

Metabolic sensing neurons control GnRH release by synapsing with which neurons?

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Question 4b

Metabolic sensing neurons control GnRH release by synapsing with which neurons?

Kisspeptin Neurons

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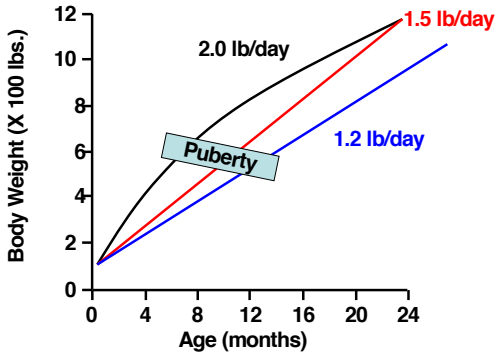
Effect of Nutrition on Puberty



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% Mature Weight at Puberty

Dairy Cattle	30-40%
Beef cattle	55-65%
Sheep	40- 63%

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Environmental and Social Conditions

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Effect of the Number of Females Housed Together and Exposure to A Male

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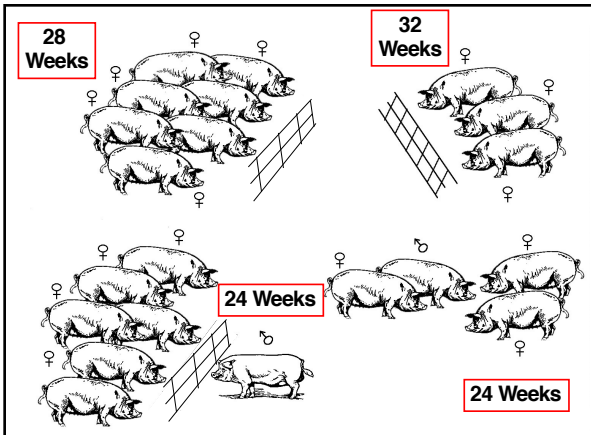

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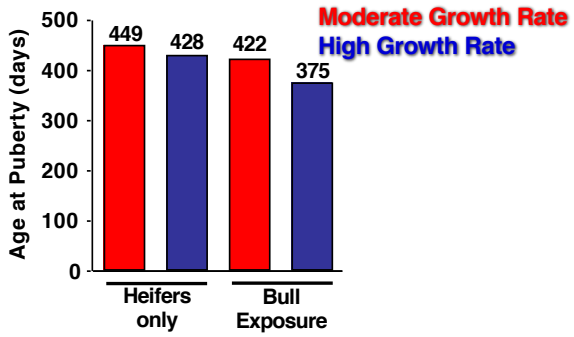
Influence of Growth Rate and Bull Exposure on Age of Puberty



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Mechanism of Social Effects

- Pheromones
- Impacts on GnRH
  - » Nasal receptors impact nerve tracts to the hypothalamus

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Hormonal

Genetic

Puberty

Environment

Nutritional

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Recommended Age to Breed

- Heifer 15 months (65% mature BW)
- Bull 15 natural mating, 12 months AI,
  9 - 10 months IVF
- Filly 2-3 years
- Colt 2 years (immature behavior until 3)
- Gilt 8 – 9 months
- Boar 9 months

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Quiz 4c

Can exposure to a male decrease the age of puberty in a female pig?

Cow?

Human?

51

Quiz 4c

Can exposure to a male decrease the age of puberty in a female pig? Yes

Cow? Yes

Human? Unknown

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