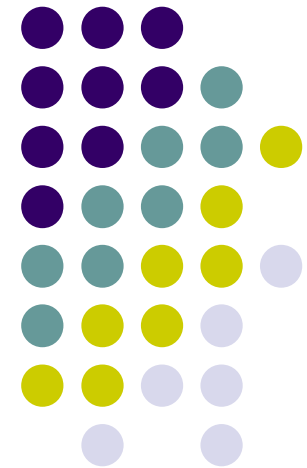


Puberty

Dr Mandy Donaldson
GEP Reproductive Medicine
January 2013

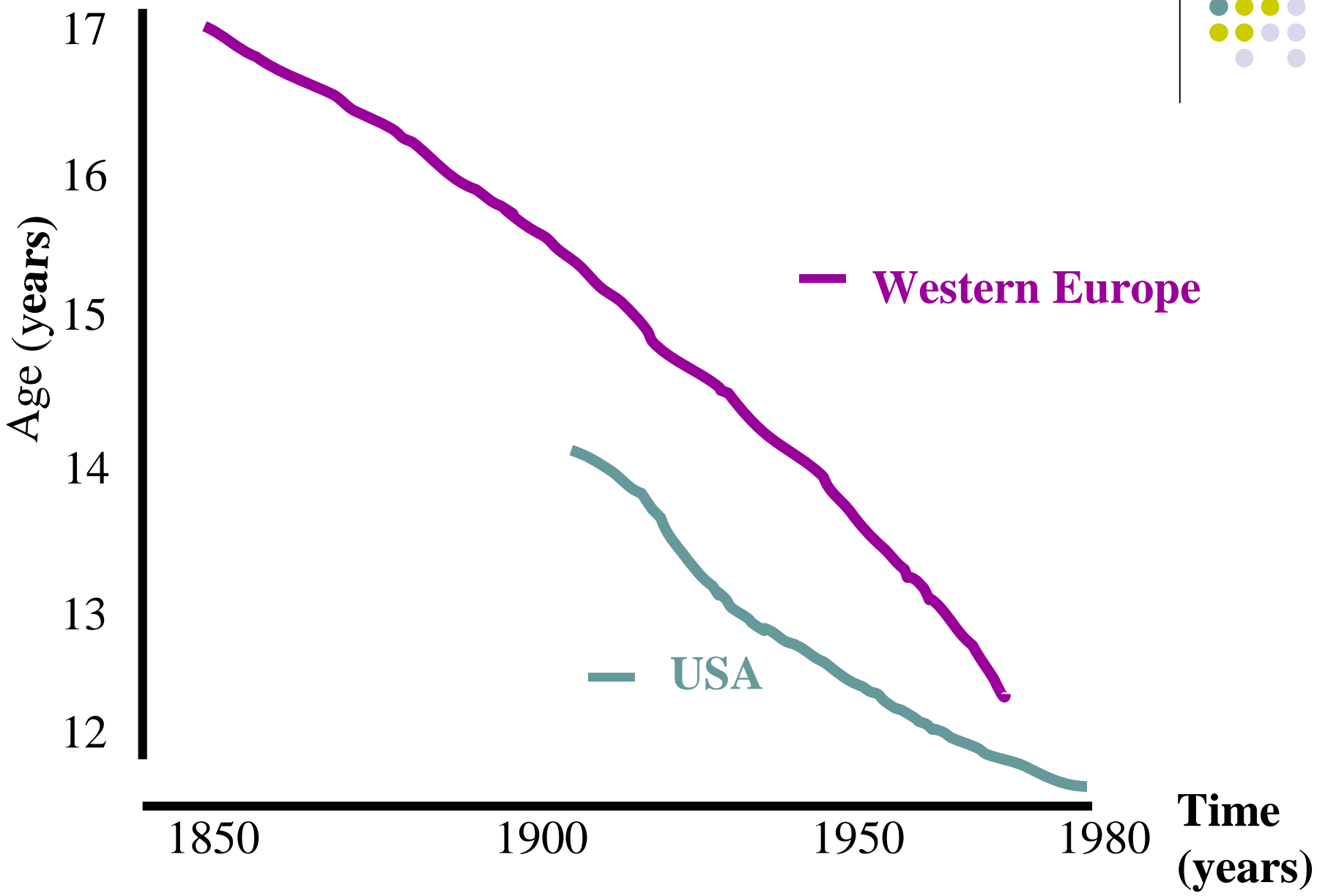
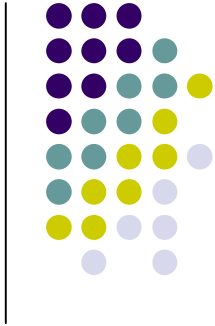




Learning Objectives

- **To be aware of the physiological and anatomical changes of puberty and how they are defined or classified**
- **To know the changes to reproductive hormones during puberty**
- **To understand the changes in feedback mechanisms occurring**
- **To be aware of the role of the possible role of leptin**
- **To be aware of the syndromes of delayed and precocious puberty**

Age at Menarche

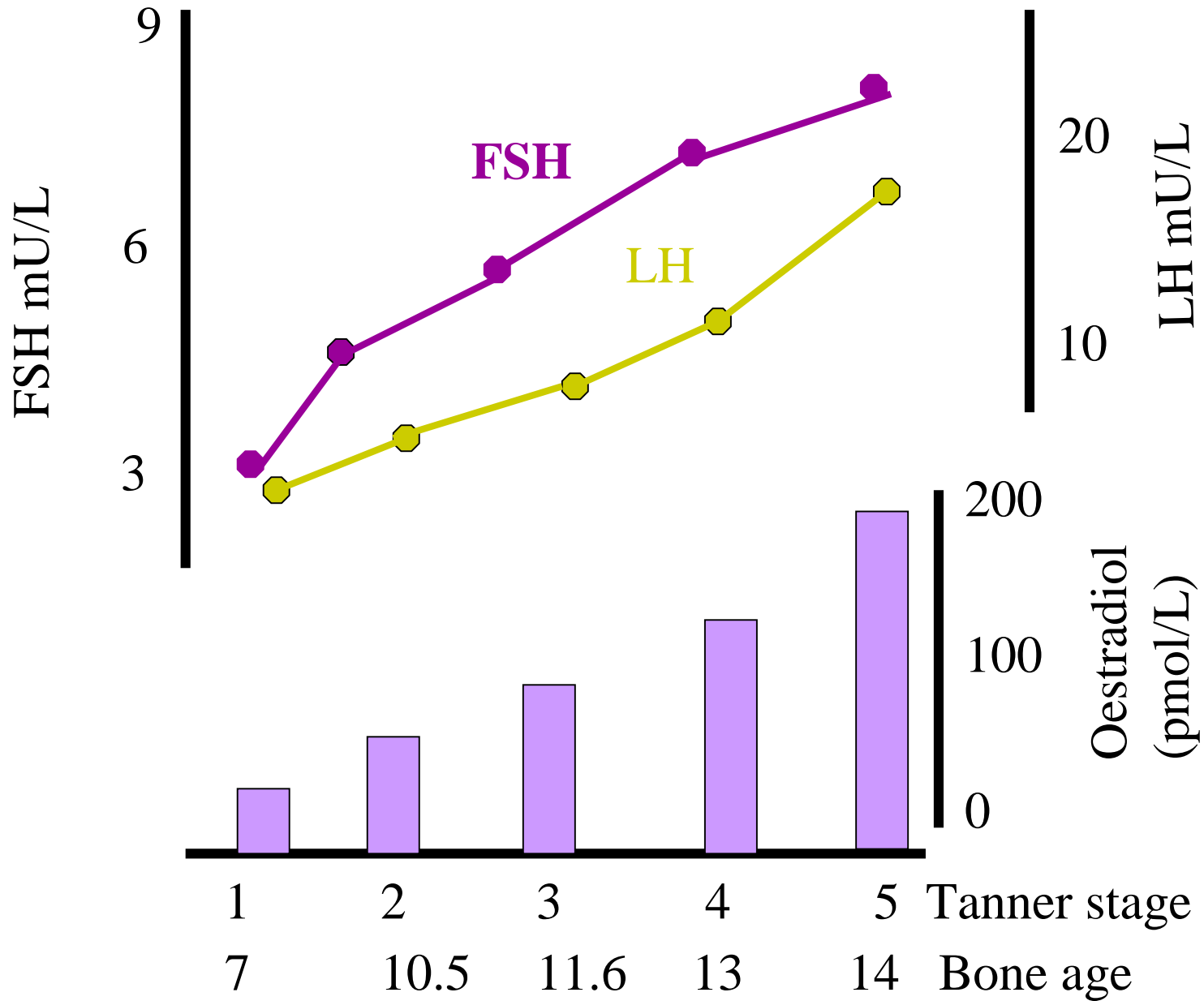


Factors Affecting Age of Menarche

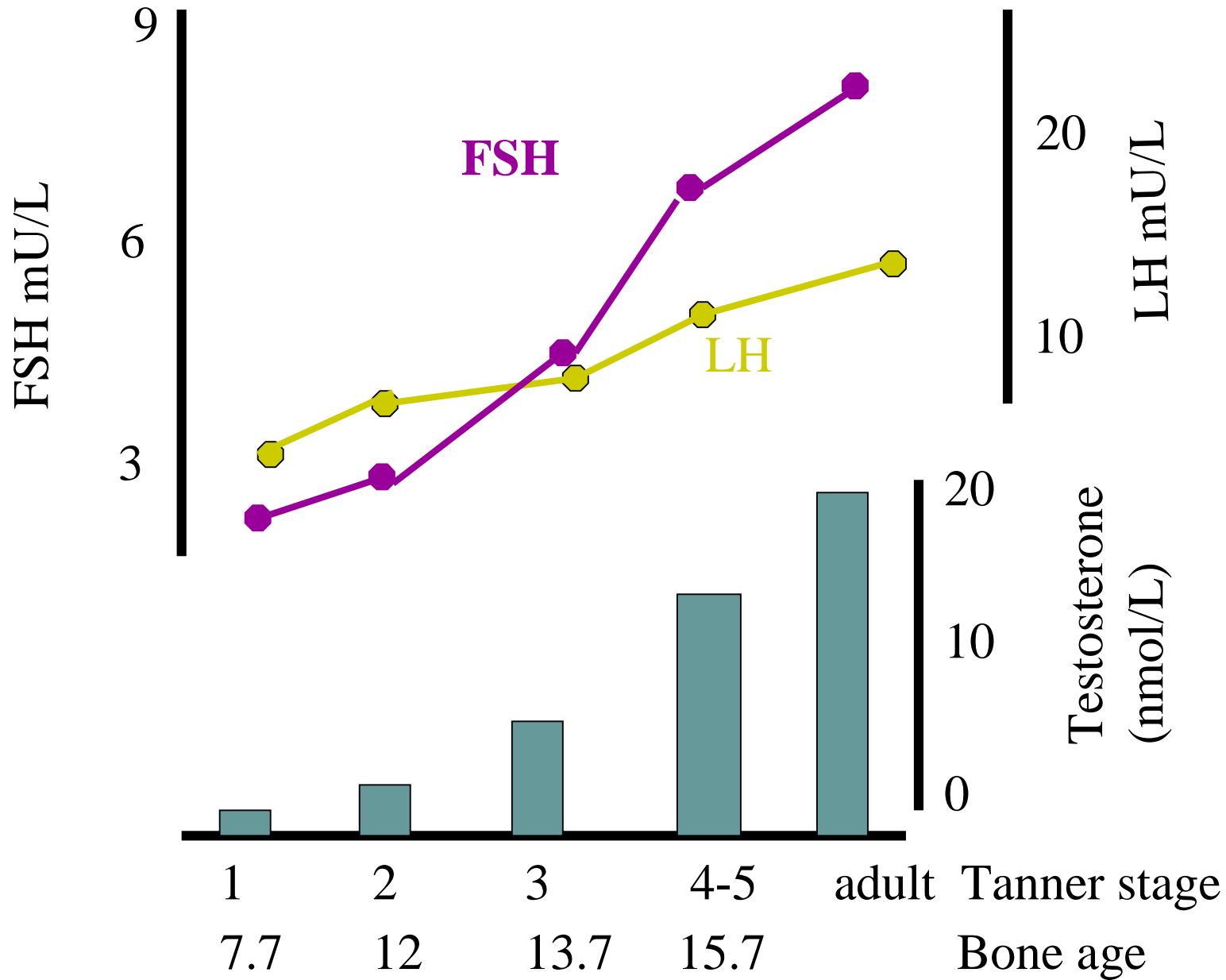


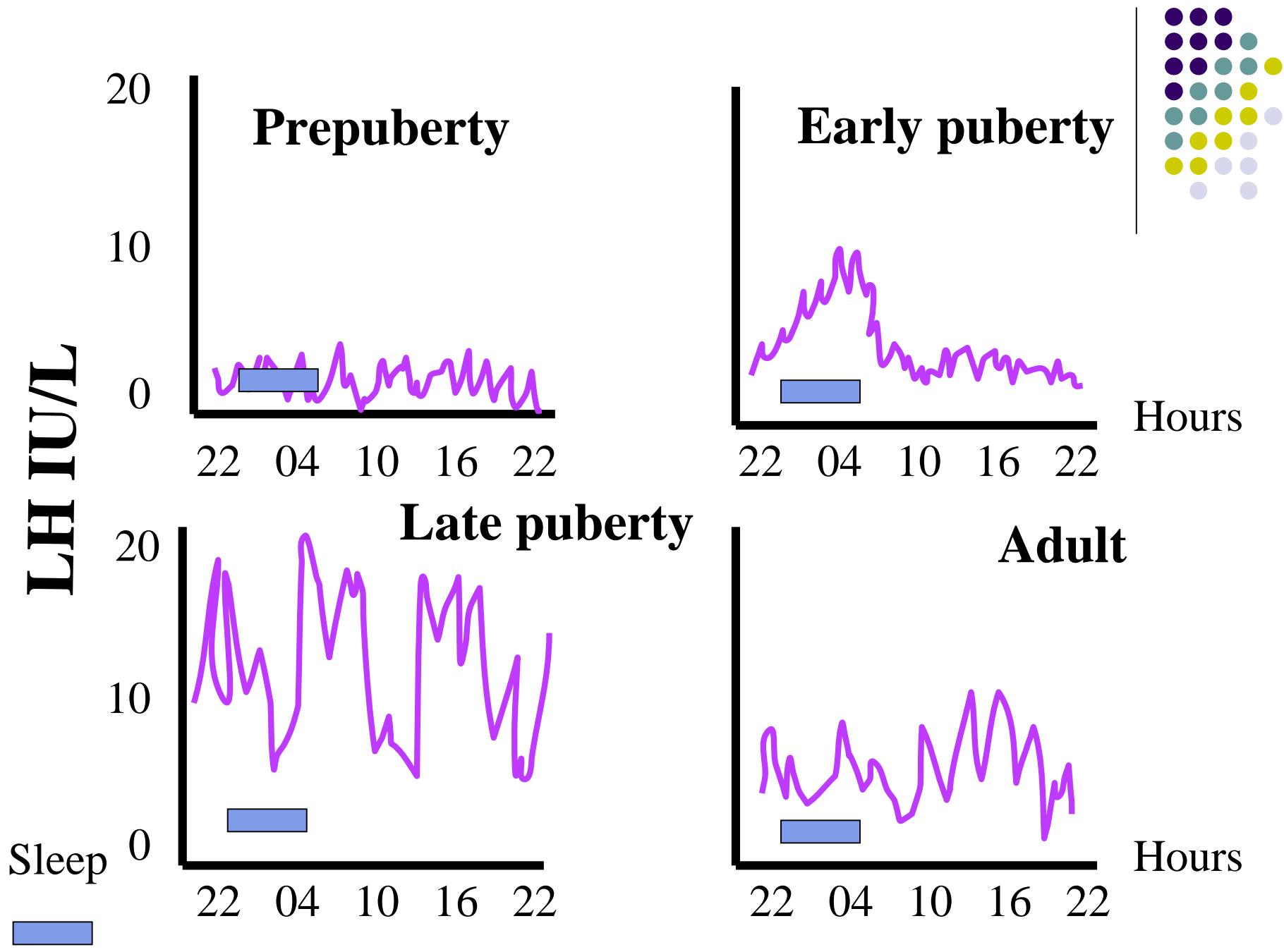
- Genetic
 - age of menarche of mother
 - ethnic group
- Physiologic/pathologic
 - percentage body fat
 - malnutrition
 - chronic disease
 - voluntary dieting
 - exercise
 - obesity

Circulating female LH FSH and E2 during puberty

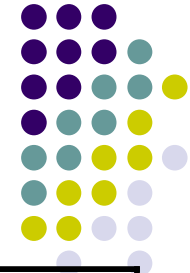


Circulating male LH FSH and Testosterone during puberty



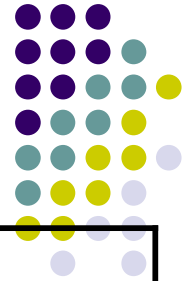


Cellular activity in the human testis



<u>Stage</u>	<u>Germ cells</u>	<u>Sertoli cells</u>	<u>Leydig cells</u>
Pre-pubertal	Prespermatogenic cells, no mature sperm	Predominant in seminiferous cords	Scattered and Partially differentiated
Pubertal	Initiation of spermatogenesis	++ Complexity Occlusive junctions formed	Fully differentiated cells appear
Adult	Active Spermatogenesis Predominant cells	Single cells associated with groups of germ cells	Groups of fully differentiated cells present

Endocrine changes in puberty



Hormone	Male	Female
LH, FSH ↑	Testes develop	Follicles develop Menstrual cycles
Sex steroids	Testosterone ↑ 2° sexual characters	Oestradiol, ↑ Breast development
DHEAS ↑	Pubic and axillary	hair growth
SHBG	↓ (Free testo ↑)	↑ (Free testo ↓)
Prolactin	-	↑ Breast development
Inhibin	From sertoli cells ↑	From granulosa cells ↑
GH & IGF ↑	Growth spurt	Growth spurt

Signal for Puberty



- Changes occur in sensitivity of feed back mechanisms - thought to be CNS driven
- An increasing number of individuals with iHH shown to have inactivating mutations of the GPR-54 receptor **Roseweir & Mills Human Reproduction Update 15, 2009**
- Damage to hypothalamus and/or pituitary can bring forward, delay or prevent puberty
- Time of puberty decreased in the developed world and has stabilised
- Childhood obesity causes earlier puberty

Evidence for leptin as the signal

- Leptin is produced by adipose tissue and increase as adipose tissue mass increases
- Individuals who do not produce leptin (very rare!) do not go through puberty.
- If leptin is given to such individuals (very small numbers) puberty proceeds
- Obese mice ob/ob have reduced Kiss-1 expression in the arcuate nucleus





Delayed puberty

- Definition- a delay of 2 SD's above the mean age for the onset of puberty (~13 years for girls and ~14 years for boys in Europe and US)
- Causes
 - Hypogonadotrophic hypogonadism
(Low GnRH, LH and FSH)
 - Hypergonatrophic hypogonadsim
(High GnRH, LH and FSH due to primary gonadal failure)

Precocious puberty



The appearance of any signs of secondary sexual characteristics at an age more than two SD,s below the mean age for puberty - in developed countries age 8 in girls and age 9 in boys

Rare syndrome with many different causes – often related to gonadal steroid exposure and more recently to childhood obesity.