

ADOLESCENT BIOLOGICAL & Physiological development

- 1. Puberty
 - a. Pre-pubertal growth spurt
 - period of rapid growth of the long bones prior to the onset of pubertal growth
 - b. ...unique to girls
- × 2. Primary & Secondary Sexual Characteristics
 - a. Primary – structures necessary for / directly involved in reproduction
 - b. Structures that communicate reproductive readiness.
 - ...not required for reproduction
- × 3. Brain Development

Next: *Facts, features & principles re pubertal growth*

ADOLESCENT BIOLOGICAL & Physiological development

- The word **puberty** is derived from the Latin word for pubescence, which means, "to grow hairy." The physical and biological changes of puberty are a central part of development during adolescence in all cultures, however the biological events interact with cultural influences.
- The endocrine system consists of glands in various parts of the body that release hormones into the bloodstream. The hormonal changes of puberty **begin in the hypothalamus**, which begins gradually to increase its production of gonadotropin-releasing hormone (GnRH) during the two years prior to puberty.
- **Fat cells produce leptin** that signal the hypothalamus to release GnRH.

Hormones:

GnRH = Gonadotropin Releasing Hormone
LH = Luteinizing Hormone
FSH = Follicle Stimulating Hormone
ACTH = Adrenocorticotropic Hormone

Leptin

Hypothalamus

Pituitary

GnRH

LH & FSH

ACTH

Feedback loop(s)

Adrenalin

Cortisol

Adrenals

Gonads:

Ovaries / F

Testes / M

Androgens

Estrogens

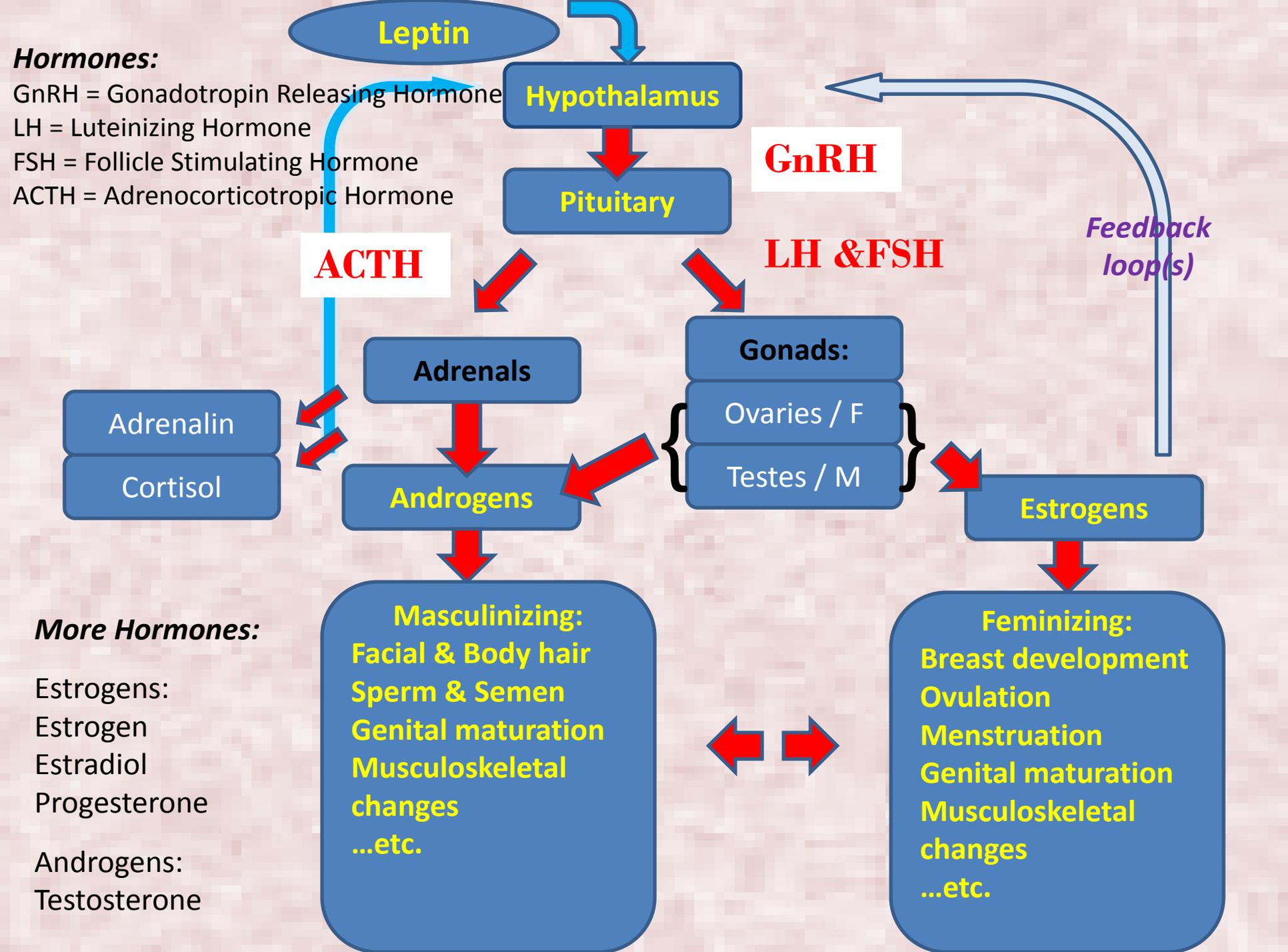
More Hormones:

Estrogens:
Estrogen
Estradiol
Progesterone

Androgens:
Testosterone

Masculinizing:
Facial & Body hair
Sperm & Semen
Genital maturation
Musculoskeletal changes
...etc.

Feminizing:
Breast development
Ovulation
Menstruation
Genital maturation
Musculoskeletal changes
...etc.



- ✘ The increase in GnRH causes the pituitary gland to release gonadotropins
 - follicle-stimulating hormone (FSH) and luteinizing hormone (LH) — that stimulate the development of gametes (egg cells in ovaries / sperm in testes).
- ✘ The ovaries and testes (also known as the gonads, or sex glands) in response to FSH and LH increase their production of the sex hormones — estrogens and androgens.
- ✘ Estradiol is the most important estrogen. Testosterone is the most important androgen. Androgens are also produced by the adrenal glands. At puberty, the pituitary gland increases production of adrenocorticotrophic hormone (ACTH), which causes the adrenal glands to increase androgen production.
- ✘ From infancy onward, a feedback loop runs between the hypothalamus, the pituitary gland, the gonads, and the adrenal glands, which monitors and adjusts the levels of the sex hormones.

Mid-teens:

Testosterone peaks: 5(M) X 1 (F)

Estrogen peaks: 4 (F) X 1 (M)

Facts, features & principles re pubertal/prepubertal growth (cont'd):

- **The adolescent growth spurt is one of the earliest signs of puberty.**
- **At **peak height velocity**, girls grow at about 3.5 inches/year**
- **...boys grow about 4.1 inches/year. Girls typically reach the beginning of their growth spurt and their peak height velocity about 2 years earlier than boys.**
- **Asynchronicity** in growth means that some parts of the body grow faster than others. The extremities are the first to hit the growth spurt.
- **(Earlier / Later) Principles of Growth: **cephalocaudal** trend
proximodistal trend**
- **There is a spurt in muscle growth due largely to the increase in testosterone, which is larger for boys (and much later than girls' growth spurt).**
- **Levels of body fat increase during puberty but more for girls than for boys.**
- **In both boys and girls, the heart becomes larger, heart rate falls and vital capacity of the lungs increases.**
- **Gender differences exist in cultural expectations for physical activity in many cultures...**
- **...as a **consequence** of differences in muscularity?**
- **... as a **cause** of differences in muscularity?**

Sexual characteristics:

Two types:

Primary:

Bodily structures and functions directly involved in reproduction

Secondary:

Those that merely communicate reproductive readiness.

- **For girls, downy pubic hair is often the first sign of the beginning of puberty, followed by breast buds.**
- **For boys, the growth of the testes is the first sign of puberty, followed by the beginning of pubic hair.**

Note: ethnic differences exist in patterns of pubertal growth.

Facts, features & principles re pubertal/prepubertal growth (cont'd):

Primary sexual characteristics:

- ✘ Females are born with 400,000/+ immature eggs, in each ovary. By puberty, this number has declined to about 80,000 in each ovary.
- ✘ Once **menarche** occurs, one follicle develops into an ovum every 28 days or so, with each ovary on a 56 day cycle. Menstruation occurs about every 28 days, sloughing off the nutritive uterine lining.
- ✘ Males have no sperm in their testes when born and do not produce any until puberty. The first production of sperm is called **spermarche** and after this, the average male produces around *350 million* sperm every day.
- ✘ In males, both the penis and the testes grow substantially in puberty.
- ✘ The prostate grows and muscles surrounding it grow stronger.
- ✘ In females, the external female sex organs — the vulva (labia majora, labia minora and the clitoris) grow substantially during puberty.
- ✘ The ovaries increase in size and weight.
- ✘ The uterus doubles in length during puberty.
- ✘ The vagina increases in length and deepens in color.
- ✘ **Vascularization** & **innervation** both extend their reach into pelvic/ genital tissues.
- ✘ Sexual arousal becomes more likely and more efficient.
- ✘ Orgasm, ejaculation, “wet dreams,” masturbation.

[F.O.L. -BBB](#)

Reactions to Puberty:

- Females:
 - **How does breast development affect self-perception in girls?**
 - **Role of height?**
 - **Impact of menarche?**
 - **Fertility?**

Early vs. late puberty

On time?

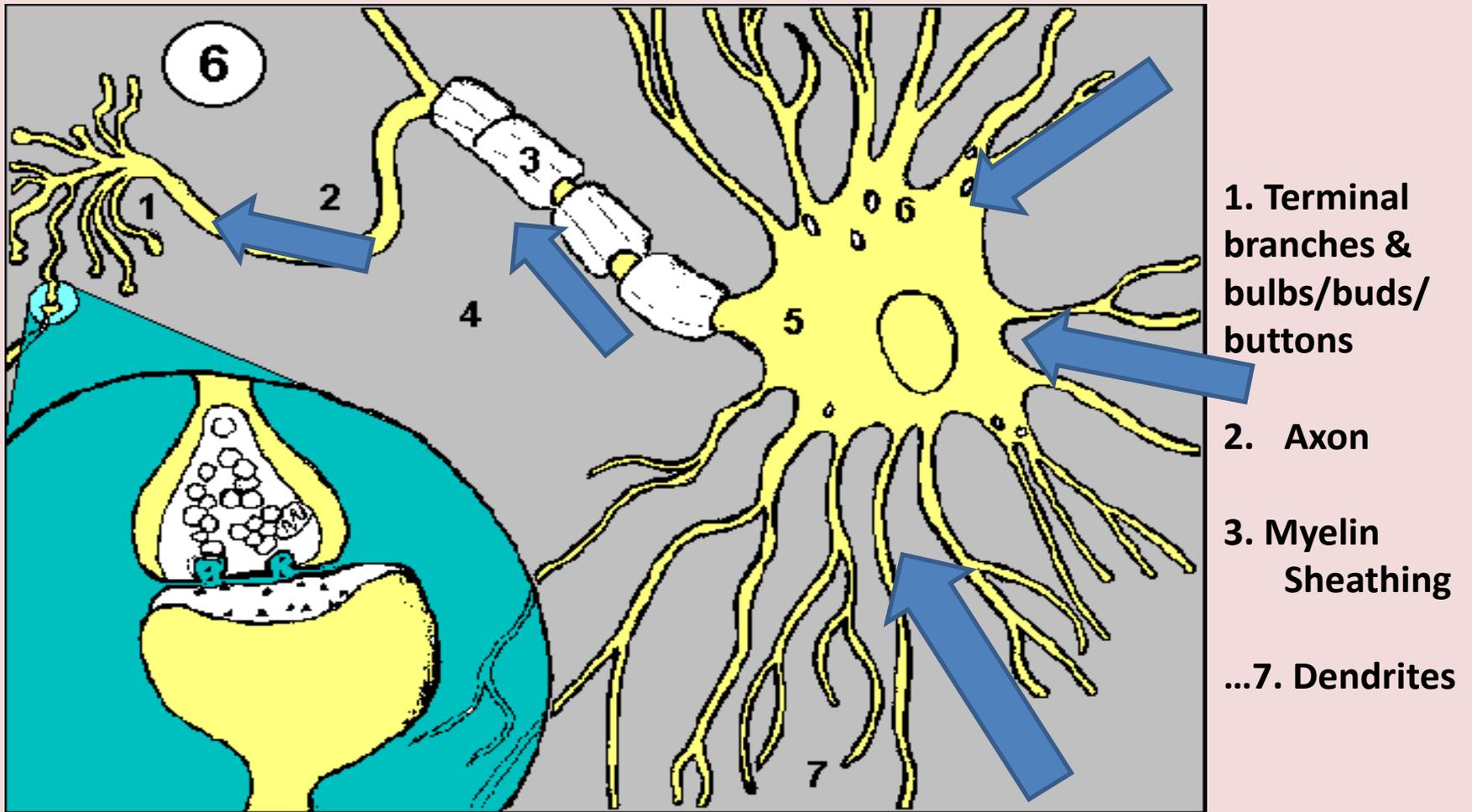
Reactions to Puberty (cont'd):

- Males:
 - **How does early puberty bring about advantages?**
 - **Disadvantages?**

 - **Late puberty**
 - **On time**

Adolescent Brain Development (cont'd):

- **Key features:**
- **Size** -enlargement of existing neurons,
- **Result:** enlargement of brain
- **Dendritic arborization**, then later d'ic. **pruning**
- **Result:** ↑ specialization of function
- **Cellular pruning** - pre-programmed cell death
- **Result:** room for growth
- ↑ **Myelinization** toward frontal areas
- **Result:** ↑ abstract reasoning, planning,
↑ awareness of principles of social behavior
- **Growth of corpus collosum**
- **Result:** greater interhemispheric signaling
- **Note:** Women vs. men



Dendritic branching, synaptic proliferation, growth in brain volume at START of adolescence.

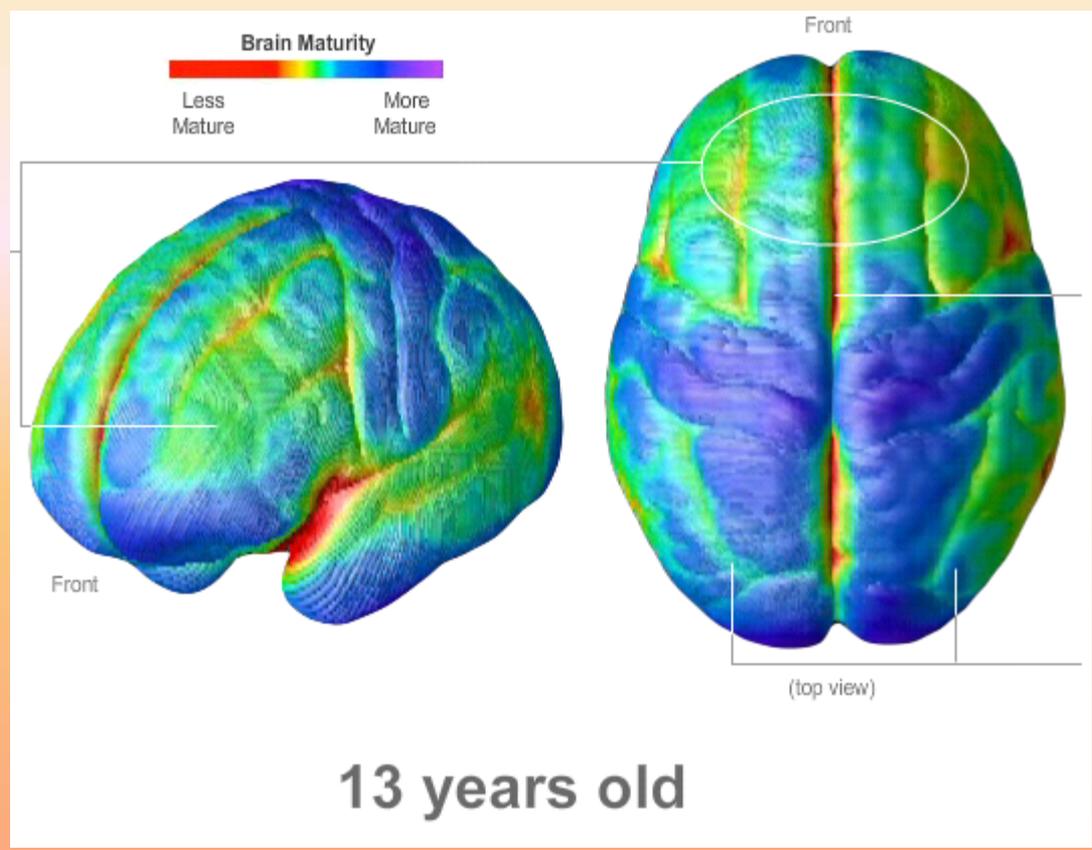
Synaptic/dendritic pruning follows.

Axonal growth continues through late teens/early twenties. FL's are target.

Continued myelinization in late adolescence → mid-twenties.

Brain Maturation:

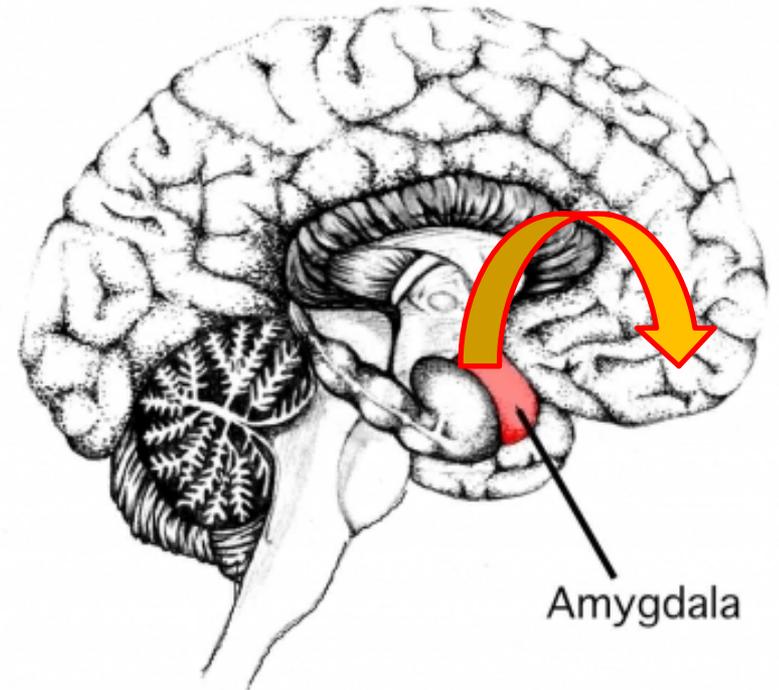
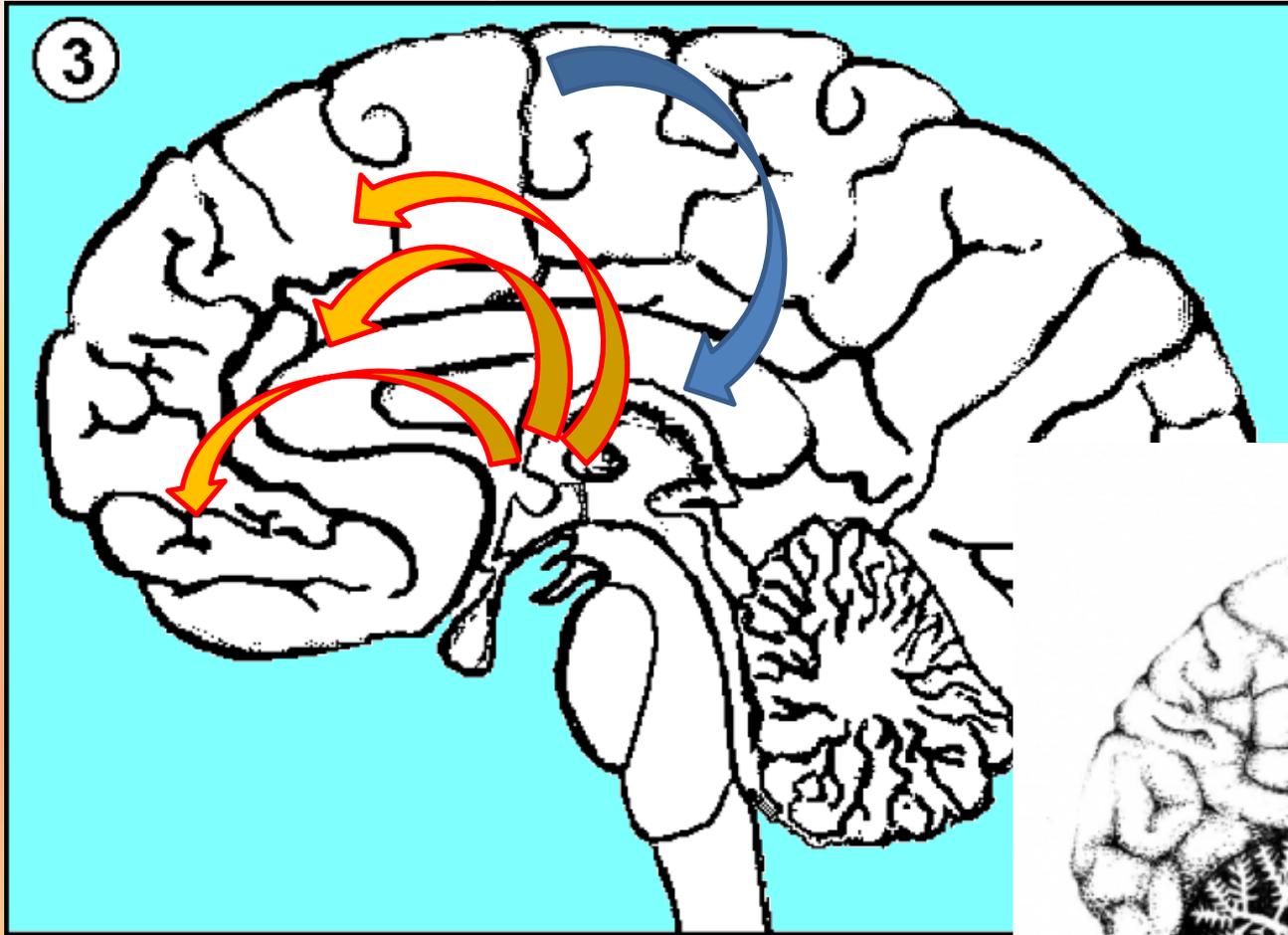
Here is a useful view of spreading cortical maturation through the years of adolescence and emerging adulthood:



<http://www.nytimes.com/interactive/2008/09/15/health/20080915-brain-development.html?oref=login>

Maturation, myelinization & the VLPC

Research by Matthew Lieberman, et al., at UCLA indicates that, “The right ventrolateral prefrontal cortex undergoes much of its development during a child’s preteen and teenage years.”



“It is possible that interaction with friends and family during these years could shape the strength of this brain region’s response, but this is not yet established.”

Adolescent Brain Development (cont'd):

- **Defining and describing Growth:**

Increases in size, structure, complexity, organization and/or function occurring over time.

- × Principles governing brain growth (a reminder):

Cephalocaudal - head to tail

-but also:

Hierarchical organization – simple to complex

Ontogenetic – growth within predetermined structural limits

Plasticity – decreasing throughout maturation

ADOLESCENT COGNITIVE DEVELOPMENT:

- Mechanisms: Learning, Brain growth, Assimilation, Accommodation, Equilibration...
- Structural Elements: Schemas
- Stages:
 - Sensorimotor Birth – 18 mos./2 yrs
 - Preoperational 2 - 5/6
 - Concrete Operational 6 – 12
 - Formal Operational 12 – Death

Emergent organization – the principle that says that increases in number, size, ability and complexity ultimately bring about increased organization, and that this produces new levels of function.

It is the *quality* of thought that is changing with each new stage.

But -- the systematic use of abstract reasoning advances throughout adolescence and emerging adulthood, even into one's late 20's/early 30's.

Achievement of Formal Operations depends on several factors:

Age	IQ	Education	Tasks assessed	Science & Math
Hands-on application of learning			Perceived need for formal, abstract analysis	

Abilities:

Abstract reasoning Formal logic Algebraic reasoning

Perception/thought about multiple aspects of an idea or event

Metaphor Sarcasm Metacognition Metamemory

Adolescent Cognitive Development (cont'd):

Deficits/limitations:

Adolescent Egocentrism

Pseudostupidity

Imaginary Audience

Personal Fable

Necessary Hero

Fated Martyrdom?

Optimistic bias

Poor risk assessment/not-to-me syndrome

F.C.

Adolescent Cognitive Development (cont'd):

- **Later adolescence/emerging adulthood:**
- **Reflective judgment**
- **Post-formal reasoning**
- **Gisela LaBouvie-Vief** : Practical thought, ambiguity, tolerance for uncertainty, dialectical reasoning
- **William Perry**:
 - Multiple thinking
 - Relativism (early 20's)
 - Commitment (mid-late 20's)

Thinking shifts from the concrete, dualistic, reductionistic thinking of childhood and early adolescence toward the more subtle and sophisticated thinking of the well educated adult.

More stuff to study:

- Information processing approach –
 - Types of memory
 - Short term eidetic, working;
 - Long term semantic, procedural, episodic
 - Arrangement of memory – associative net vs. hierarchical structure
 - Types of attention
 - Selective
 - Divided
 - Freedom from distraction
 - Concentration

Other issues in advancing cog-dev:

- **Memory capacity:**
 - A. Immediate short term, sensory or eidetic memory
 - Requires rehearsal.
 - Supplies long-term memory stores through repetition and hot cognition.
 - B. Working memory
 - Requires repeated accessing to stay active, but is less conscious.
 - Involves use of metamemory.
 - Correlates well with IQ.
 - Teens get better at accessing it through tricks, systems of recall, mnemonic devices.
 - C. Long term storage, recognition and recall.
 - “Unlimited” but...
 - ...prone to distortion.

Structure of memory

- Linear chains of association
- Hierarchical
- Network

Lev Vygotsky:

Memory as a socially constructed and reconstructed phenomenon