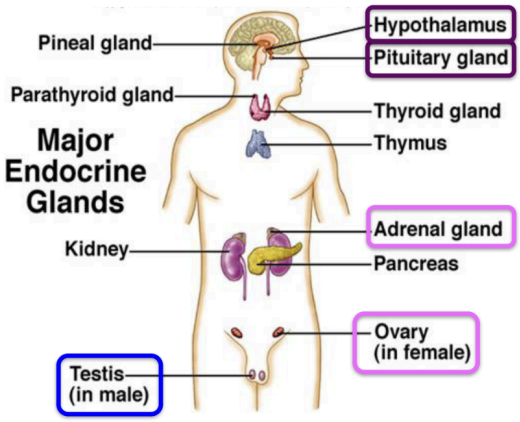
sexual development and behavior

hypothalamus and pituitary

- hypothalamus– interface with endocrine system via pituitary (master) gland
- produces releasing hormones that flow via blood vessels to anterior pituitary
- releases other hormones as neurotransmitters via axons to posterior pituitary
- pituitary releases triggered hormones into bloodstream of the body → sends messages to other glands
    - 

masculine and feminine

- androgens (male) and estrogens (females) hormones
    - both present in both sexes just varying amount
- complex set of factors influence gender–genes, neurotransmitters, hormones, culture

organizing effects

- development of sexual anatomy including brain differences

prenatal development

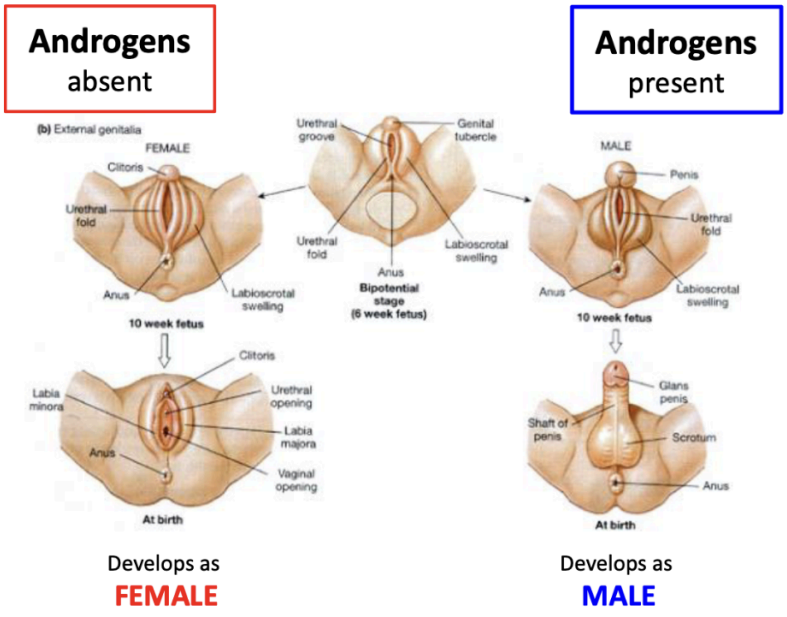
- genes (TDF testes determining factor)
    - found only on Y chromosome
    - enzyme appears at 6~8 weeks
    - switch activates testosterone production
        - in absence of such testosterone, development will default to female form

fetal development

internal anatomy

- sexual anatomy develops by 4th month
- start out with both systems "all purpose" gonads
    - female duct – mullerian
    - male duct – wolffian
- androgens present triggers anti mullerian hormone 00 degeneration of mullerian ducts
    - develops as male
- androgens absent triggers degeneration of wolffian ducts
    - develops as female

external anatomy



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turner's syndrome

- X0–missing second sex chromosome
- develop as female though infertile

androgen insensitivity

- even if have TDF and produce testosterone, cells may be insensitive to its effects
- body develops internally and externally as female
    - though no secondary hair growth and infertile

masculinizing effects of excessive estrogens

- as treatment for repeated miscarriage, pregnant women in 1950s received excessive estrogens
    - could result in masculinized fetus → clitoris like head of penis

        - testosterone and estrogen very similar–when testosterone enters cells it is converted (aromatized) into estrogen → estrogen masculinizes all males
- why mother's estrogens masculinize every fetus – **alpha feto protein**
    - protein binds with mother's estrogen, allowing own hormones to determine its gender
    - excessive estrogens administered overwhelmed this safeguard, partially masculinizing fetus

postnatal development

- secondary sexual characteristics
    - at adolescence (both sexes), hypothalamus releases GnRH (gonadotropin-releasing hormones)
        - anterior pituitary to release gonadotropins LH and FSH
            - stimulate testes in males to releases testosterone – adult male form
            - stimulate ovaries in females to release estrogen – adult female form
                - EXCEPT androgen androstenedione from adrenals required for hair growth in females

gender differences in brains

- in males
    - hypothalamus
        - MPOA in medial preoptic nucleus–including sexually dimorphic nucleus
        - SDN 2.5x bigger in males
            - filled with testosterone receptors
    - male brains optimized for intrahemispheric communication
        - perception and coordinated action
- in females
    - hypothalamus
        - VMH in ventromedial nucleus significantly larger in females
        - regulates feeding behavior esp critical in females "eating for two" (mother and fetus)
    - female brains for interhemispheric communication
        - analytical and intuitive processing
- INAH3
    - enlarged portion of sexually dimorphic nucleus of hypothalamus MPOA
    - larger in straight males, smaller in females and gay men

activating effects

male sexual behavior

- MPOA releases GnRH
- anterior pituitary releases LH and FSH
- circulate to testes, releases testosterone→ feeds back to MPOA, escalating arousal

- pleasure circuits
    - VTA ventral tegmental area responds by releasing dopamine to nucleus accumbens (reward center)
- MPOA also stimulates basal ganglia → signals SBN (spinal nucleus of the bulbocavernosus)--> rhythmic contractions for ejaculation
- at orgasm: MPOA signals posterior pituitary to release oxytocin
    - after ejaculation anterior pituitary releases prolactin → refractory period
- MPOA reciprocates interaction with medial amygdala and other parts of limbic system
    - plays role in aggression effects of testosterone
    - responds to pheromones
- cortex: learned associations can stimulate and mediate sexual response
    - especially prefrontal and visual cortex
    - unlike many smell driven mammals, primate sexual signals tend to be visual

female sexual behavior

- libido also a function of androgens but originate from adrenal glands instead of MPOA
    - androstenedione released by adrenals get converted in bloodstream to testosterone
        - circulating testosterone impacts both MPOA and VMH
- testosterone causes MPOA to release GnRH → anterior pituitary releases LH and FSH →circulate to ovaries, release estrogens → feedback to VMH, escalating arousal
- VTA (ventral tegmental area) responds by releasing dopamine to nucleus accumbens
- basal ganglia signals SBN for rhythmic contractions
- cortex plays role in learned responses
- medial amygdala in limbic system activated (including response to pheromones)
- VMH stimulates periaqueductal gray (PAG) area of midbrains → endorphins
    - endorphins add to pleasure and help prevent pain
- at orgasm, posterior pituitary releases oxytocin
    - unlike in males – no follow up release of prolactin
    - prolactin stimulates milk production in pregnant/lactating females

limbic system's role in mediating sexual response

- class of smells: pheromones – hormones in sweat, released in air to communicate about reproductive state
- in most mammals, smell controls limbic responses
    - specialized vomeronasal organ (VNO) directs pheromones → trigger reproductive behaviors
    - unclear if humans/primates have VNO but we still respond to pheromones
- in humans:
    - smell info goes directly to amygdala and other parts of limbic system
        - limbic system also called rhinencephalon (nose brain)
    - olfactory receptor cell axons pass through pores in skull → synapse onto mitral cells in olfactory bulb
- effects of pheromones on human male mating behavior

    - aftershave spiked with male pheromones → find more receptive females
- effects of pheromones on human female behavior
    - subjects had sweat of another female dabbed on upper lip everyday → synchronizing menstrual cycles with sweat donors
    - in primates may help assure reproduce at similar times to share child care