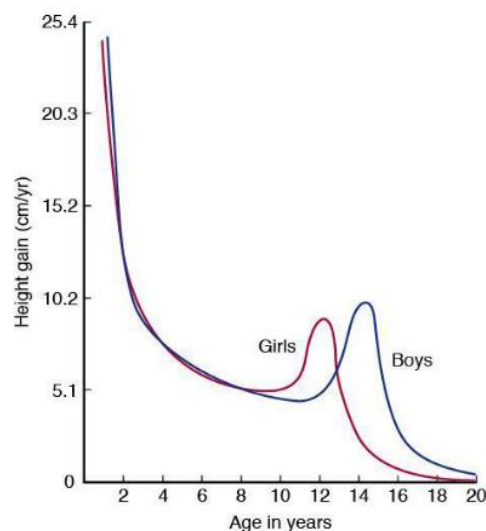




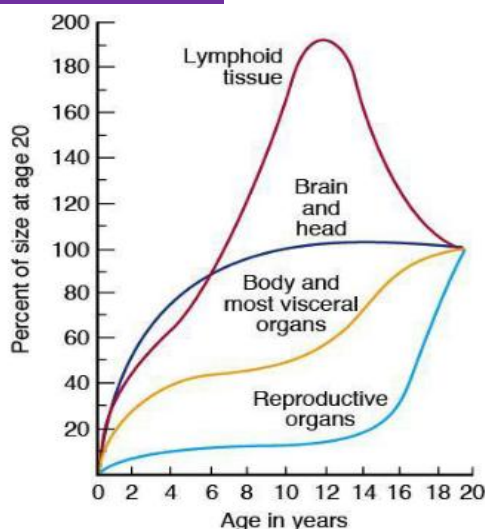
- There are two periods of accelerated growth in humans (see the graph):

- The first is the one which occurs in infancy and considered as continuation of growth which has been occurring to the fetus in the uterus.
- The second is the growth spurt during puberty which occurs mainly due to the release of the following hormones:
 - ✓ Growth Hormone (GH) and Insulin-Like Growth Factors.
 - ✓ Androgens (testosterone from testes in males).
 - ✓ Estrogens (from ovaries in females).
 - ✓ Thyroid hormones.



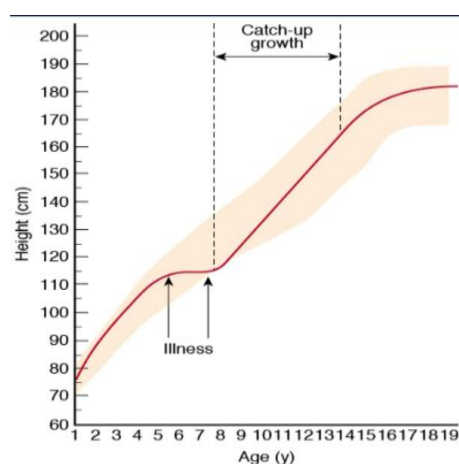
This growth spurt which occurs during puberty will stop later due to epiphysis closure in long bones (e.g. humerus and femur) and there will be no further increase in height. Notice that the age of puberty is less in females (it occurs before males) thus growth spurt in females will start earlier but at the same time epiphyseal closure will be earlier and this explains why most of females are short.

- The graph below shows growth of different tissues at various ages as a percentage of size at age 20 (PLEASE MEMORIZE THIS GRAPH AS THEY ALWAYS BRING IT AS A QUESTION IN OSPE EXAM):



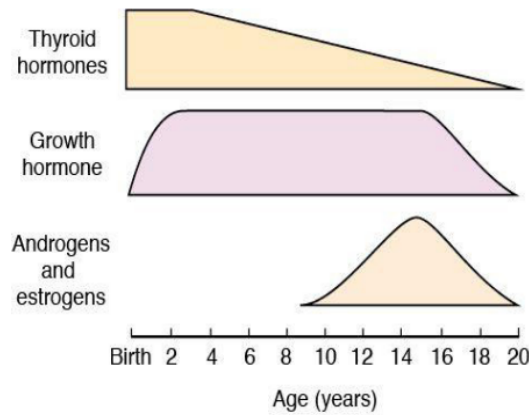
- Catch-up growth:

- Catch-up growth is characterized by height velocity above the limits of normal for age for at least 1 year after a transient period of growth inhibition; it can be complete or incomplete. Although catch-up growth can be expressed in terms of height velocity, the change in height standard deviation score is more appropriate. Catch-up growth is difficult to distinguish from the pubertal growth spurt. It is not possible to know whether catch-up growth is complete for an individual child, but if final height is within the target range, it can be considered that catch-up growth has probably been complete.

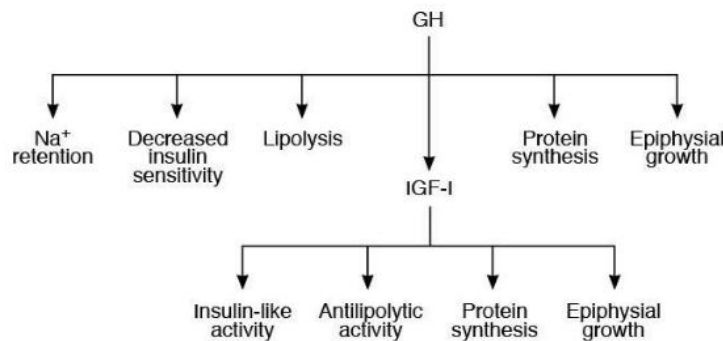




- The graph below shows relative importance of hormones in human growth at various ages:



- **Notice that thyroid hormones (T3 & T4) are really important in (early growth).** Congenital deficiency of thyroid hormones results in cretinism (which is characterized by restricted physical growth –because GH secretion will be depressed too- and mental retardation). In hypothyroid children, bone growth is slowed and epiphyseal closure is delayed because thyroid hormones play a role in ossification of cartilages.
- **Growth Hormone is required throughout the period of growth until you become an adult.** The hypothalamus produces Growth Hormone Releasing Hormone (GHRH) which stimulates anterior pituitary gland to secrete the Growth Hormone (GH) that will move to the liver and will be converted to its active form (somatomedin) that in turn exerts negative feedback on the level of anterior pituitary and hypothalamus to inhibit further (GH) secretion. Functions of growth hormone are summarized below:



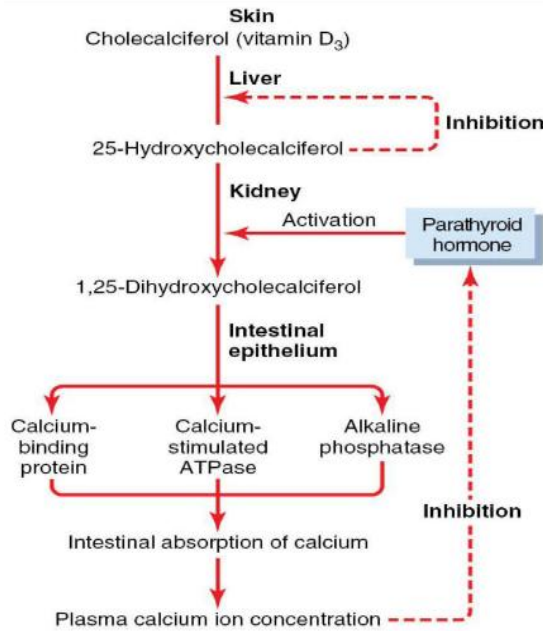
Factors stimulating (GH) secretion	Factors inhibiting (GH) secretion
↓glucose and free fatty acids	↑glucose and free fatty acids
Puberty (androgens and estrogens)	Senescence
Fasting, exercise and sleep	Somatomedin and somatostatin

- **Androgens and estrogen start to be secreted from gonads at time of puberty** when the pattern of GnRH secretion from hypothalamus changes from being continuous to pulsatile.
- **Insulin and growth:**
 - Pregnant females with diabetes or Gestational Diabetes Mellitus (GDM) will have high blood glucose levels → this in turn will be faced by the fetus by increased insulin production from the pancreas causing him to be in a hyperinsulinemia condition → and as insulin participates in growth → the baby will be macrosomic (large baby weighing > 4.5 kg) with a lot of complications.
 - When there is insulin deficiency, there will be loss of lean body mass.
- **Glucocorticoids:**
 - Hypersecretion of glucocorticoids (such as that which is occurring in Cushing’s Syndrome) causes cessation of growth because this affect cartilage formation and bone synthesis.



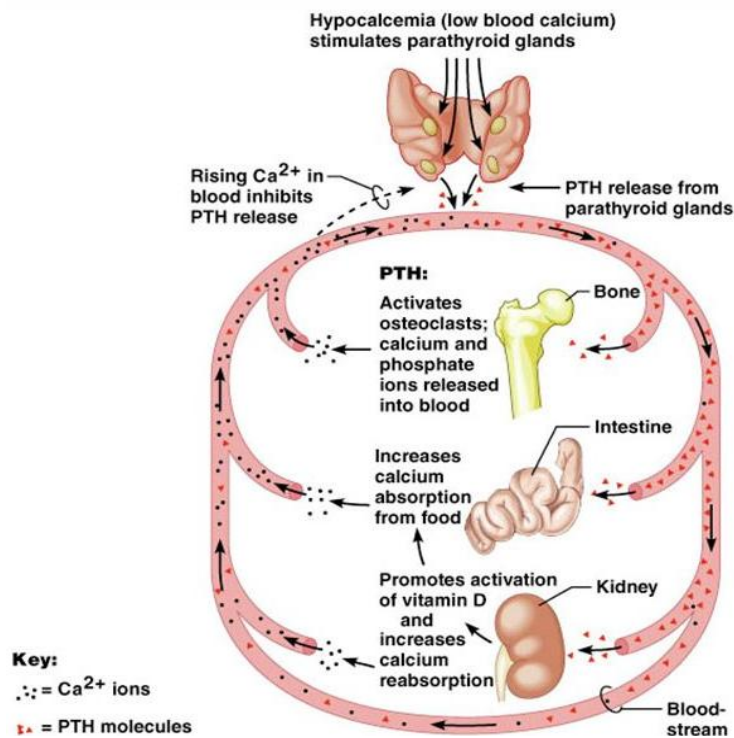
- **Vitamin D:**

- **Vitamin D is a pro-hormone which has to be converted to its hormonally active metabolite that is known as (calcitriol) or (1,25 dihydroxycholecalciferol).**



- **What are the functions of vitamin D?**

- ✓ Enhancing intestinal absorption of calcium.
- ✓ Promoting renal reabsorption of calcium.
- ✓ Promoting bone formation and mineralization.
- ✓ Inhibiting parathyroid hormone secretion, which if secreted, will result in the following:



- **What could be the causes of vitamin D deficiency?**

- ✓ Reduced dietary intake and exposure to sunlight.
 - ✓ Malabsorption.
 - ✓ Liver or kidney disorders (why?) → because these two organs are involved in conversion of vitamin D to its active form.
- Vitamin D deficiency results in rickets (in children) and osteomalacia (in adults).