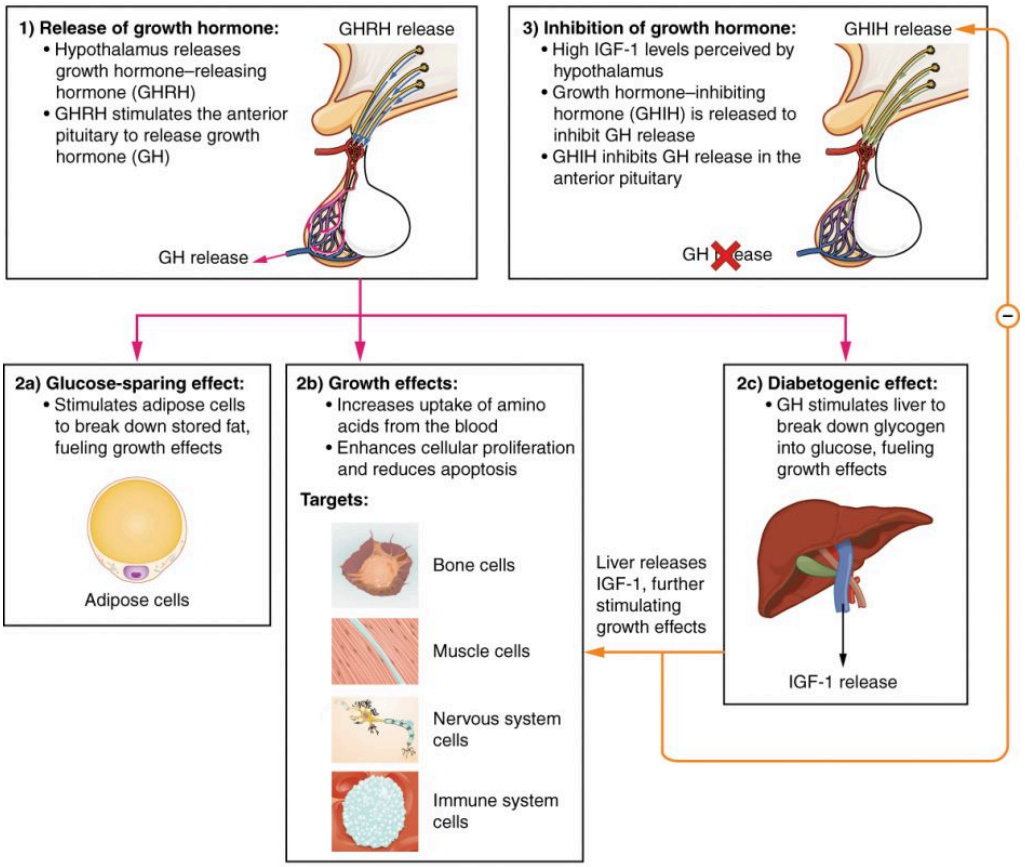
5.5.4

# Growth Hormone

Growth in the human is not controlled by a single hormone, instead, growth requires the careful balance between growth hormone, thyroid hormones, insulin and the sex hormones, as well as proper nutrition. Nevertheless, growth hormone appears to be especially important in children, and its primary actions are essential for normal growth. Growth hormone is secreted by somatotrophic cells in the anterior pituitary gland under the control of growth hormone releasing hormone (GHRH) and growth hormone inhibiting hormone (GHIH) from the hypothalamus. Growth hormone secretion exhibits a 24-hour (circadian) pattern with peak release occurring at night during deep sleep. In addition, various stimuli can influence its release. For example, low blood sugar levels (hypoglycemia) stimulate its release while high blood glucose levels inhibit its release. Stress also increases growth hormone secretion.

Growth hormone has both direct and indirect actions. Direct actions include: increased uptake of amino acids and production of proteins by the cells, increased breakdown of fats (lipolysis) and release of fatty acids by the fat cells, and increased synthesis and release of glucose (gluconeogenesis) into the blood by the liver, and decreased uptake of glucose by muscle and fat cells. This combination ensures that muscle cells have the energy they need from fatty acids and saves the glucose for use by nervous tissue. The overall direct effect of growth hormone is to increase lipid utilization and the promotion of protein synthesis and growth.




Hormonal Regulation of Growth



The indirect actions of growth hormone are mediated via messengers released by the liver. Growth hormone stimulates the secretion of a group of messengers called somatomedins, the most important of which are the insulin-like growth factors. These messengers stimulate the growth of cartilage and bone as well as increase protein synthesis in skeletal muscle.

Several growth disorders are associated with improper secretion of growth hormone. Growth hormone deficiency occurring prior to puberty results in a condition called **dwarfism or hypopituitary dwarfism**. Individuals with this disorder do not attain adult heights and depending on the onset of the condition may only be a few feet tall. With this type of dwarfism, the individuals are short but exhibit normal body proportions. Prior to 1985 treatment of these children required harvesting growth hormone from human pituitaries that were collected during autopsies. Obviously, the supply was limited and since the children needed daily injections to attain a normal height there wasn't enough to go around. Also, the window for treatment is fairly small because once the growth plates close after the onset of puberty, treatment is no longer effective. Thanks to recombinant DNA technology, since 1985 human growth hormone has been produced in large quantities using bacteria that express the human growth hormone gene.

The other side of the issue is excess growth hormone. This is usually the result of a growth hormone-secreting tumor either in the pituitary or somewhere else in the body. If this occurs prior to puberty it will result in **gigantism**. Those suffering from this condition can reach heights of well over 7 feet, with the largest known cases approaching 9 feet tall. If the condition starts after puberty it results in a condition known as **acromegaly.** Although the long bones have stopped growing, other bones in the body can continue to grow. Individuals suffering from acromegaly exhibit large hands and feet, large jaws and supraoptic ridges. In addition, some soft tissues are also stimulated by the excess growth hormone such as the tongue, liver, heart and abdominal organs. Think of Andre the Giant (Princess Bride, arguably the best movie ever made), he suffered from gigantism as well as acromegaly.