

# Thyroxine (Thyroid Hormone)

## Encyclopedia Article

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# Contents

[Thyroxine \(Thyroid Hormone\) Encyclopedia Article.....1](#)

[Contents.....2](#)

[Thyroxine \(Thyroid Hormone\).....3](#)



# Thyroxine (Thyroid Hormone)

Thyroxine is the principal hormone produced by the thyroid gland. It promotes protein synthesis and growth, and also helps regulate the body's metabolism (oxygen use and heat production).

Thyroxine is often called T4, because of its four iodine atoms ( $C_{15}H_{11}I_4NO_4$ ). Both thyroxine and the other major thyroid hormone triiodothyronine (T3, with 3 iodine atoms) are protein hormones, closely related to the amino acid tyrosine ( $CH_9NO_3$ ).

The thyroid gland produces thyroxine after a series of hormone signals. When the blood's thyroxine level is low, the brain's hypothalamus produces thyrotropin-releasing hormone, which stimulates the pituitary gland to produce thyrotropin (TSH or thyroid-stimulating hormone). TSH then stimulates the thyroid gland. When the blood's thyroxine level is high, the hypothalamus releases a hormone that inhibits TSH production.

Overactive thyroid glands (hyperthyroidism) can cause weight loss, nervousness, and protruding eyes, as in Graves's disease, first identified by the Irish physician Robert James Graves (1796-1853). A low thyroxine level (hypothyroidism) lowers the metabolic rate. If this happens in infancy and early childhood over a long period, mental and physical underdevelopment can result. At the end of the nineteenth century, the German chemist Eugen Baumann (1846-1896) was the first to treat people's underactive thyroids with extracts made from animal thyroid glands. In 1914, the American biochemist Edward Kendall isolated and used the crystalline form of the hormone, which was later named thyroxine. In 1926 the British chemist C. R. Harington (1897-1972) determined thyroxine's exact structure and synthesized it.

Today overactive glands can be treated with medication. They can also be removed surgically or destroyed by radiation, in which case the patient takes thyroid hormones as replacement therapy. Hormone therapy is also used for underactive glands. The first widely-used test to measure people's thyroid levels was developed in the 1930s by the American biochemist Evelyn B. Man (1904-1992). Called the protein-bound iodine test, it soon showed that many "demented" patients in mental hospitals actually had underactive thyroid glands. Treatments with thyroxine helped many of them regain normal mental abilities. Doctors now routinely measure the ratio of thyroxine to TSH in blood from newborn babies' umbilical cords. This allows correction of any thyroid gland problem before mental or physical damage occurs.