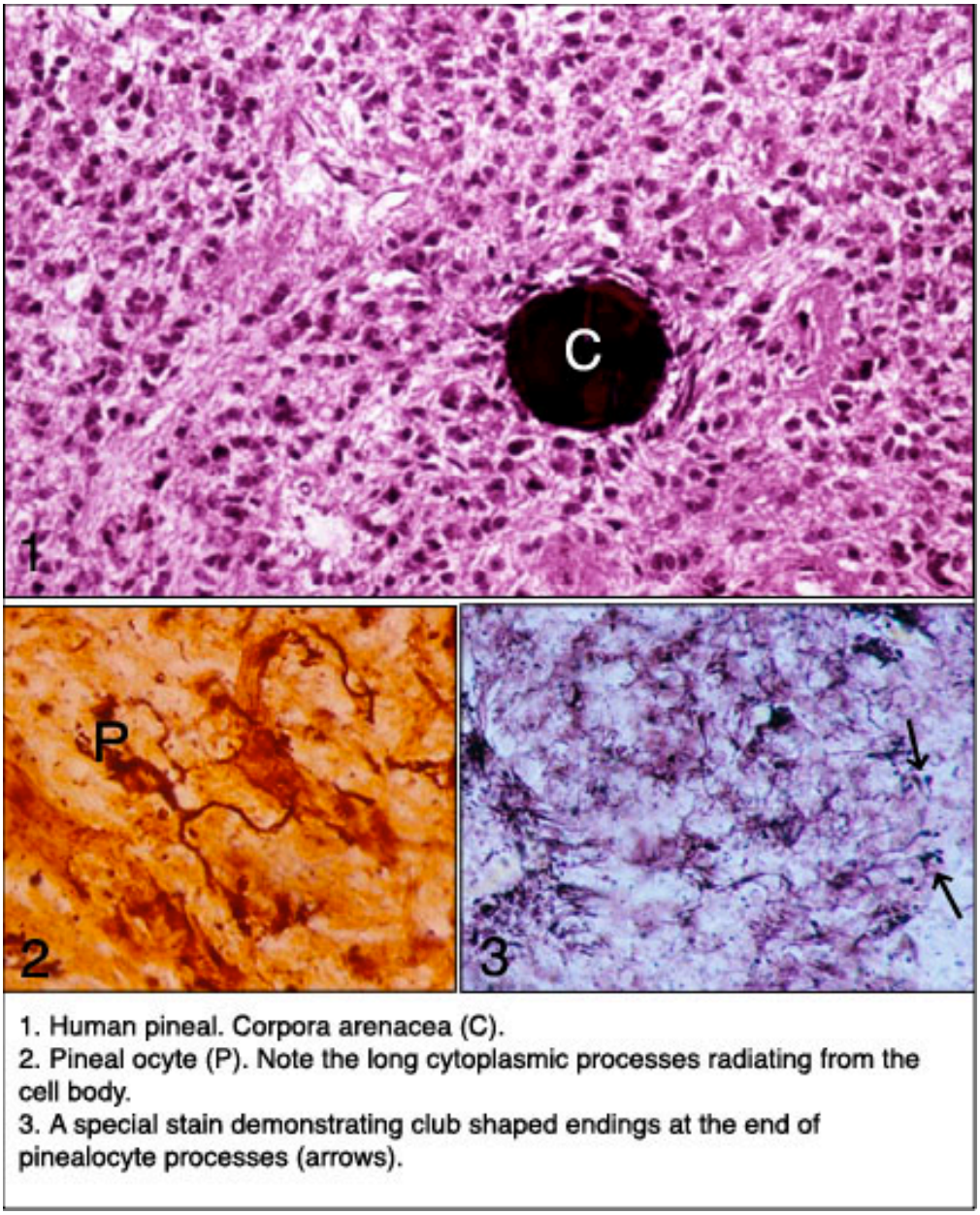
Pineal



1. Human pineal. Corpora arenacea (C).
2. Pineal ocyte (P). Note the long cytoplasmic processes radiating from the cell body.
3. A special stain demonstrating club shaped endings at the end of pinealocyte processes (arrows).

The human pineal gland is a somewhat flattened body 5 to 8 mm long and 3 to 5 mm wide. In the adult it weighs about 0.1 gm. It is attached to the brain (roof of the diencephalon) by a short stalk that contains small blood vessels, some nerve fibers and their supportive elements. The pineal gland is included in a group of circumventricular organs that lack a blood-brain barrier.

The pineal is covered by a thin connective tissue capsule that is continuous with the surrounding meningeal (pial) tissue. Richly vascularized and innervated septa extend into the parenchyma of the gland and subdivide it into poorly defined lobules. Two types of cells, pinealocytes and glial cells, are present organized into clumps and cords. Pinealocytes have relatively large lobulated nuclei. Long cytoplasmic processes often radiate from the cell body to form club-shaped endings near adjacent perivascular spaces or adjacent pinealocytes. Small, membrane-bound vesicles, some with electron-dense cores, are present in the swollen ends of the processes. Synaptic ribbons may be present also. Nearer the cell body, the cytoplasm

contains abundant, fairly large mitochondria, numerous free ribosomes, profiles of smooth endoplasmic reticulum, lipid droplets, lipochrome pigment, lysosomes, and large numbers of microtubules and intermediate filaments. Numerous gap junctions link groups of pinealocytes electrically and metabolically. Although light and dark forms have been described, it is unknown whether each forms a distinct cell type or whether they represent differences in the activity of a single cell type. Glial cells form an interwoven network within and around the parenchymal cords and clumps of the pineal gland. They are fewer in number than pinealocytes and their nuclei are smaller and stain more deeply. Glial cells show long cytoplasmic processes and often are regarded as a form of astrocyte. The cytoplasm contains many fine filaments, 5 to 6 nm in diameter, which may form large bundles. Corpora arenacea (brain sand) are concretions found in the pineal gland. These irregularly shaped structures occur in the capsule and substance of the gland. They consist mainly of calcium carbonates and phosphates within an organic matrix. In humans, they increase with age beginning after puberty, but their significance is unknown. The pineal gland has an extensive blood supply and is provided with many postganglionic sympathetic nerve fibers from neurons in the superior cervical ganglia.

The pineal gland produces melatonin, an indolamine. In mammals such as the rat, pinealocytes synthesize serotonin, a precursor of melatonin that varies cyclically (circadian and seasonal) in amount and changes in relation to the amount of light. Serotonin levels fall and melatonin levels rise during darkness. These circadian rhythms are controlled by the release of norepinephrine from the sympathetic fibers that enter the pineal from the superior cervical ganglia, which in turn is controlled by the light perceived by the retina. In some rodents and birds the pineal, through secretion of melatonin, plays an active role in the reproductive cycles, which are influenced by the length of day light (photoperiod). The pineal in these species acts as a photo neuroendocrine organ, influencing the gonads in response to light. The function of the pineal and melatonin in humans, however, is poorly understood. Melatonin is thought to inhibit gonadotropin activity before puberty and therefore acts to prevent the onset of puberty before the appropriate age. Pineal-specific peptides produced by the pineal also are thought to influence or mediate hypophyseal function, but their exact role is uncertain. The human pineal begins to produce melatonin at about three months of age. Production of melatonin falls steadily after puberty.