Nervous co-ordination gives control. Endocrine co-ordination regulates changes.

The two systems interact in a dynamic way in order to maintain the constancy of the animal's internal environment, while permitting changes in response to a varying external environment. Both systems secrete chemicals, the nervous system as a transmitter between neurones and the endocrine system as its sole means of communication between various organs and tissues in the body. Adrenaline acts both as a hormone and a nervous transmitter.

26.1 Principles of Endocrine Control
- **endocrine glands:** ductless glands secreting chemical messengers (hormones) which diffuse directly into blood and carried to target organs to exert a specific physiological effects

Examples:
- Islets of Langerhans (in pancreas): secretes insulin which changes glucose into glycogen to lower blood glucose concentration
- **Adrenal gland** secretes adrenalin which prepares our body for emergencies
- **Pituitary:** master gland; **Hypothalamus:** manager

### 26.1.1 Chemistry of Hormones
- **Polypeptides** (less than 100 amino acids) - oxytocin, insulin, glucagon, antidiuretic hormone (vasopressin)
- **Proteins** - prolactin, follicle stimulating hormone, luteinizing hormone, thyroid stimulating hormone, adrenocorticotrophic hormone, growth hormone
- **Amines** - adrenaline, noradrenaline, thyroxine
- **Steroids** - oestrogen, progesterone, testosterone, cortisone, aldosterone

### 26.1.2 Nature of Hormone Action
- not required in syllabus

26.2 The Pituitary Gland
It produces a large number of hormones which influence the activity of other endocrine glands. It depends upon information received from the hypothalamus.

The pituitary is divided two portions:
- anterior pituitary - glandular tissue communicating with the hypothalamus by blood vessels
- posterior pituitary - an outgrowth of the hypothalamus communicated
Hormones & Functions:

<table>
<thead>
<tr>
<th>Hormones</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anterior pituitary:</strong></td>
<td></td>
</tr>
<tr>
<td>Thyroid stimulating hormone (TSH)</td>
<td>1 stimulates growth of thyroid gland</td>
</tr>
<tr>
<td></td>
<td>2 stimulates thyroid to secrete thyroxine</td>
</tr>
<tr>
<td>Adrenocorticotropic hormone (ACTH)</td>
<td>1 regulates the growth of the adrenal cortex</td>
</tr>
<tr>
<td></td>
<td>2 stimulates adrenal cortex to produce cortisone (a hormone)</td>
</tr>
<tr>
<td>Follicle stimulating hormone (FSH)</td>
<td>1 initiates development of Graafian follicles</td>
</tr>
<tr>
<td></td>
<td>2 initiate sperm formation in testes</td>
</tr>
<tr>
<td>Luteinizing hormone (LH) OR interstitial cell</td>
<td>1 causes release of ovum &amp; development of follicle into corpus luteum</td>
</tr>
<tr>
<td>stimulating hormone (ICSH)</td>
<td>2 stimulate secretion of testosterone from interstitial cells of testes</td>
</tr>
<tr>
<td>Prolactin</td>
<td>1 maintains progesterone production from corpus luteum</td>
</tr>
<tr>
<td></td>
<td>2 induces milk production in pregnant females</td>
</tr>
<tr>
<td>Growth hormone (GH)</td>
<td>promotes growth</td>
</tr>
<tr>
<td><strong>Posterior pituitary:</strong></td>
<td></td>
</tr>
<tr>
<td>Anti-diuretic hormone (ADH)</td>
<td>1 reduces amount of water loss from kidney</td>
</tr>
<tr>
<td></td>
<td>2 raises blood pressure by constricting arterioles</td>
</tr>
<tr>
<td>Oxytocin</td>
<td>1 induces birth by causing uterine contractions</td>
</tr>
<tr>
<td></td>
<td>2 induces lactation</td>
</tr>
</tbody>
</table>

26.2.1 The Anterior Pituitary

The production of its hormones is determined by small peptides (releasing factors) produced by the hypothalamus through blood vessels.

26.2.2 The Posterior Pituitary

Hormones are produced by the hypothalamus & stored in posterior pituitary. They are released by nervous impulses from the hypothalamus.

26.3 The Hypothalamus

Functions:
1. It regulates activities such as sleep, thirst & temperature control
2. It monitors the level of hormones & other hormones in blood passing through
3. It controls the functioning of the anterior pituitary
4. It produces ADH & oxytocin which are stored in the posterior pituitary

The hypothalamus is the link between the nervous and endocrine systems for homeostasis.

**Role of the hypothalamus as the link between nervous and endocrine systems**
Example: control of thyroxine production by thyroid gland

26.4 The Thyroid Gland
- thyroxine regulates growth & development of cells;
  - increase rate of glucose oxidation
  → heat production to regulate body temperature
- controls metabolism, thus works closely with insulin, adrenaline & cortisone
- chemically: derivative of tyrosine (a.a.) and iodine

26.5 The Adrenal Glands
26.5.1 The Adrenal Cortex
- All hormones produced are steroids formed from cholesterol
  - glucocorticoids: for glucose metabolism
  - mineralcorticoids: for mineral metabolism,
    - e.g. aldosterone regulates water retention by controlling the distribution of Na and other minerals
26.5.2 The Adrenal Medulla
- two hormones: adrenaline & noradrenaline for preparing body for action (flight or fight hormones)
- cell producing them are modified neurones, e.g. noradrenaline by sympathetic system
- adrenaline dilates blood vessels of muscles but noradrenaline constricts those in internal organs

26.6 The Pancreas
exocrine gland: secretes pancreatic juice
endocrine gland: secretes insulin (alpha cells) & glucagon (beta cells)
diabetes mellitus: a disease due to insufficient insulin production

26.7 Other Hormone-like Substances - not required in syllabus