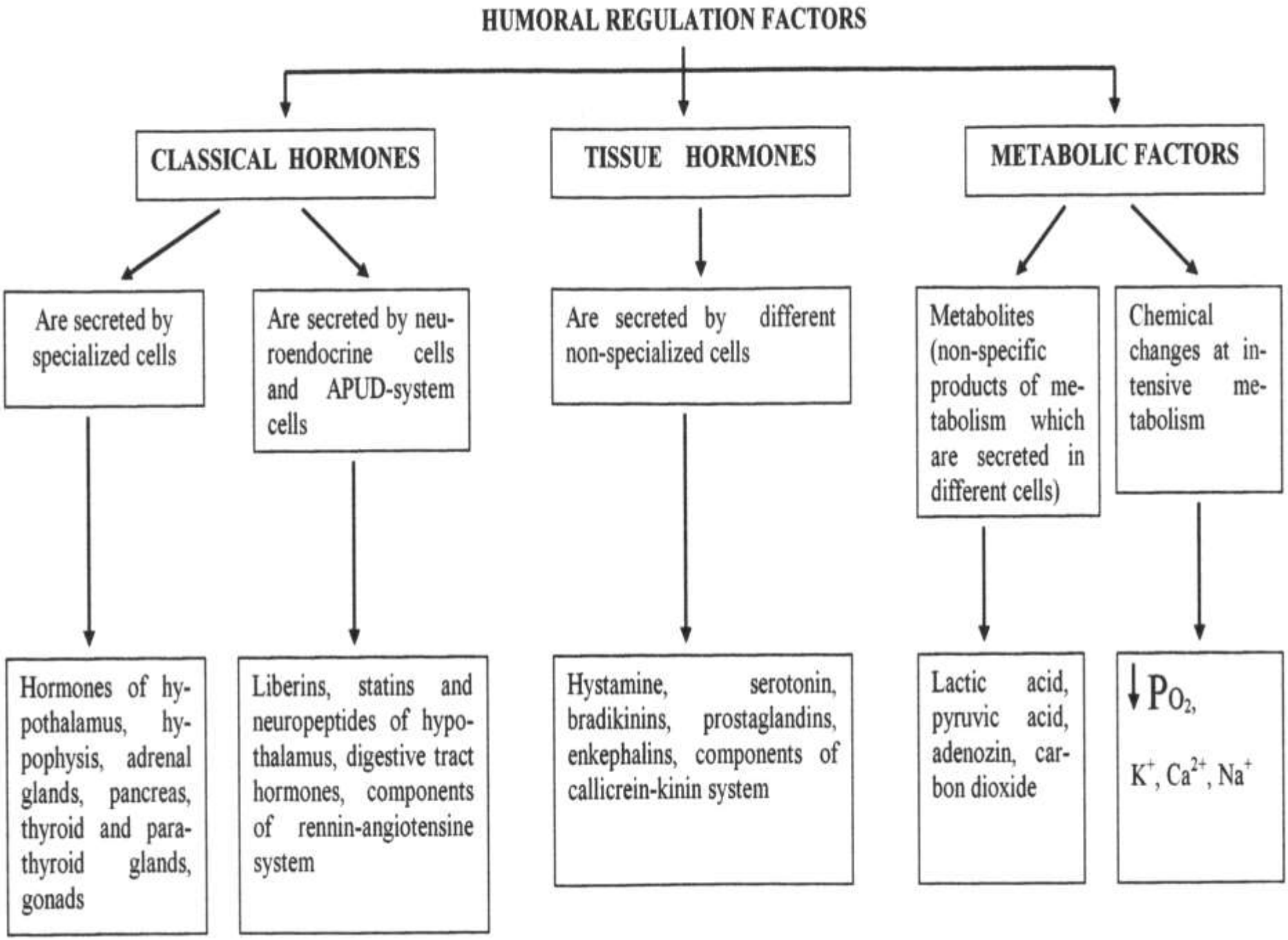
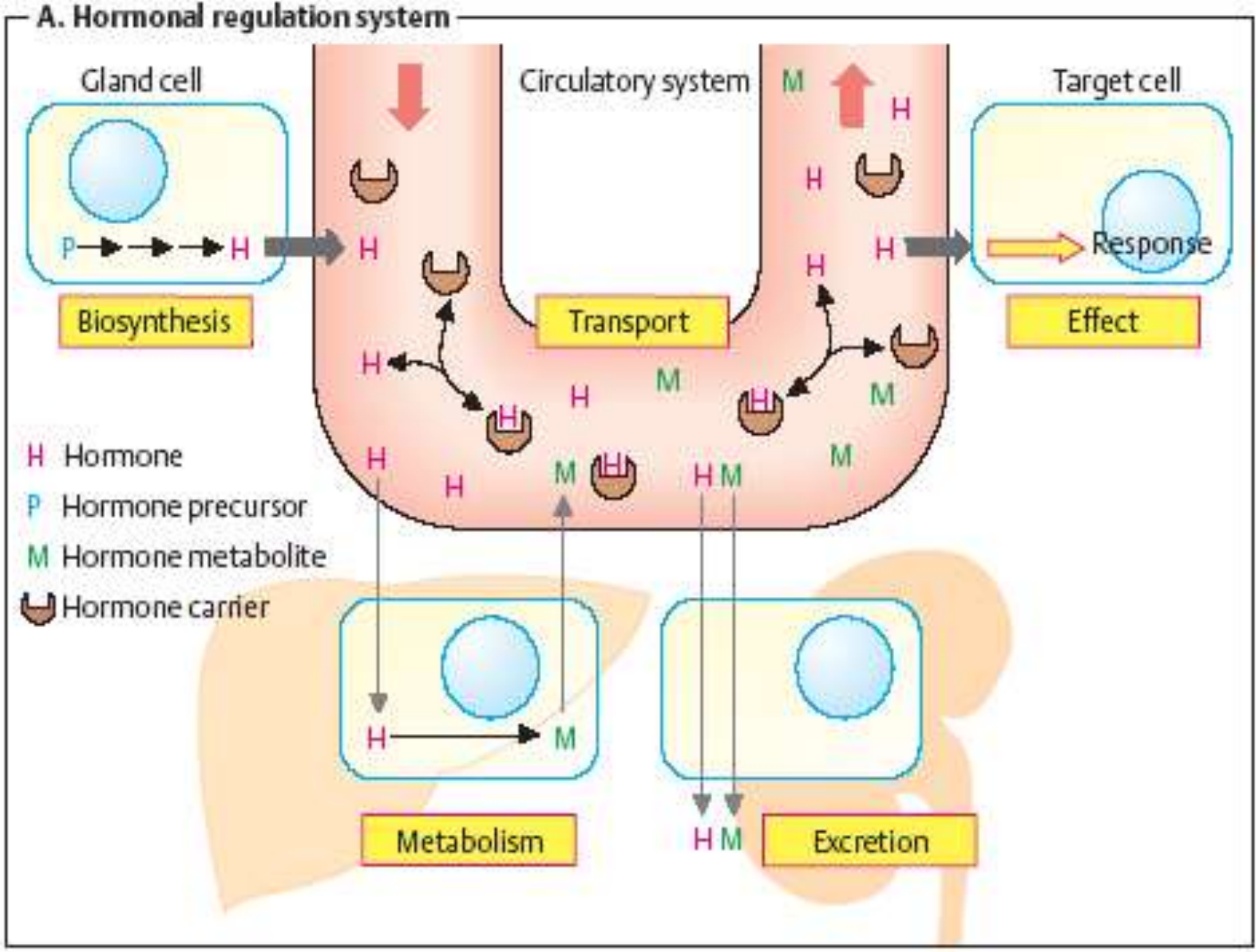
Lecture 8. Humoral regulation: factors, mechanisms of hormone action on the target cells, regulation of hormonal secretion

Principles of hormonal regulation

- Hormones are substances which can change the status, function, metabolism and structure of body organs and tissues.

- True hormones are released into blood stream
- Act only on target cells
- Active in very low doses
- May stay active for months


HUMORAL REGULATION FACTORS
CLASSICAL HORMONES
TISSUE HORMONES
METABOLIC FACTORS
Are secreted by specialized cells
Are secreted by neuroendocrine cells and APUD-system cells
Are secreted by different non-specialized cells
Metabolites (non-specific products of metabolism which are secreted in different cells)
Chemical changes at intensive metabolism
Hormones of hypothalamus, hypophysis, adrenal glands, pancreas, thyroid and parathyroid glands, gonads
Liberins, statins and neuropeptides of hypothalamus, digestive tract hormones, components of rennin-angiotensine system
Hystamine, serotonin, bradikinins, prostaglandins, enkephalins, components of callicrein-kinin system
Lactic acid, pyruvic acid, adenozin, carbon dioxide
↓ P_{O_2},
K^+, Ca^{2+}, Na^+


A. Hormonal regulation system
Gland cell
Circulatory system
Target cell
P
H
M
Response
Biosynthesis
Transport
Effect
H Hormone
P Hormone precursor
M Hormone metabolite
Hormone carrier
Metabolism
Excretion

Types of hormone action

- Metabolic
- Morphogenic
- Kinetic
- Corrective

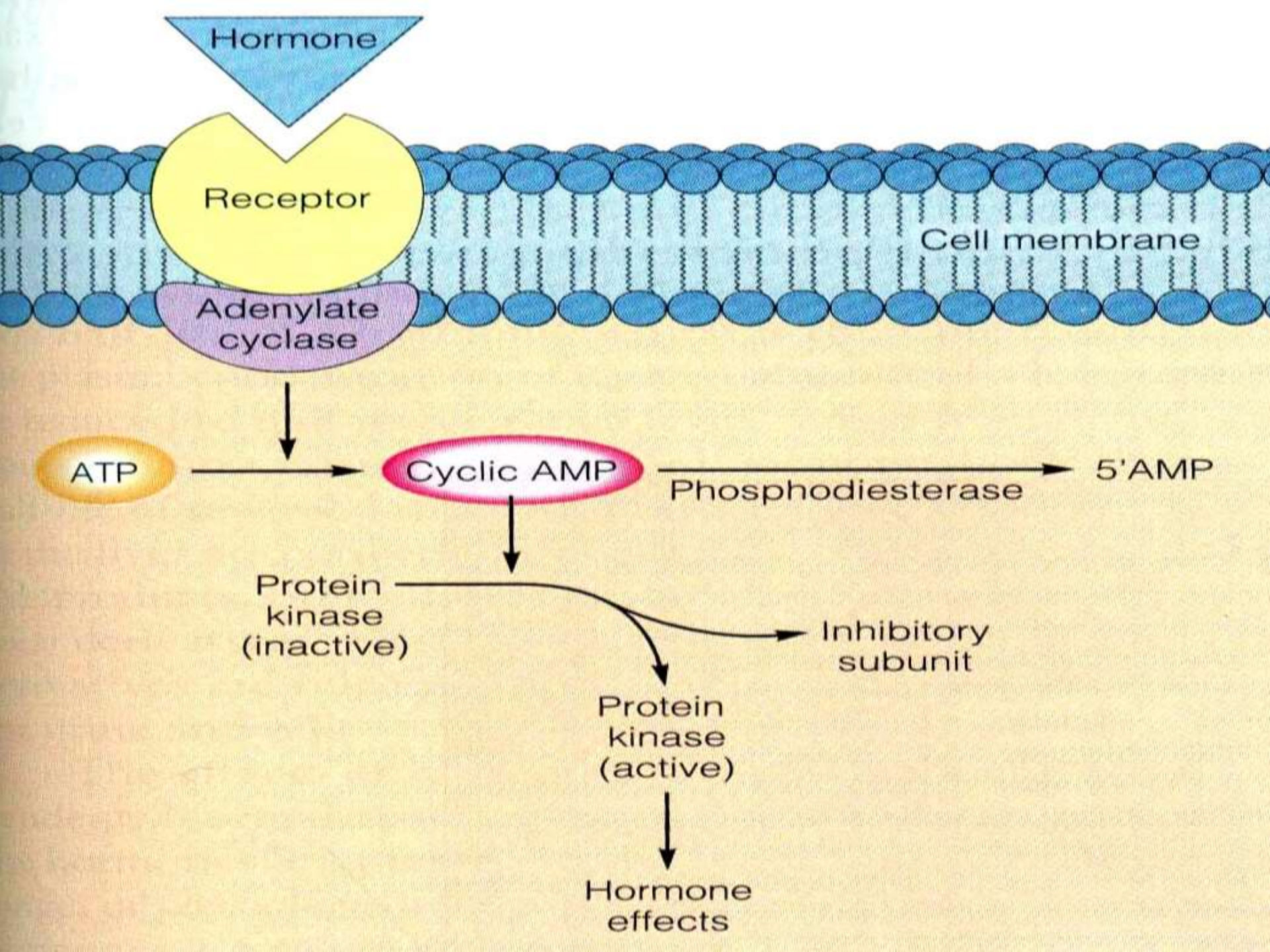
Hormones classification

- Biochemical classification:

1. Steroids
2. Amino-acid derivatives
3. Protein-peptide compounds

- Functional classification:

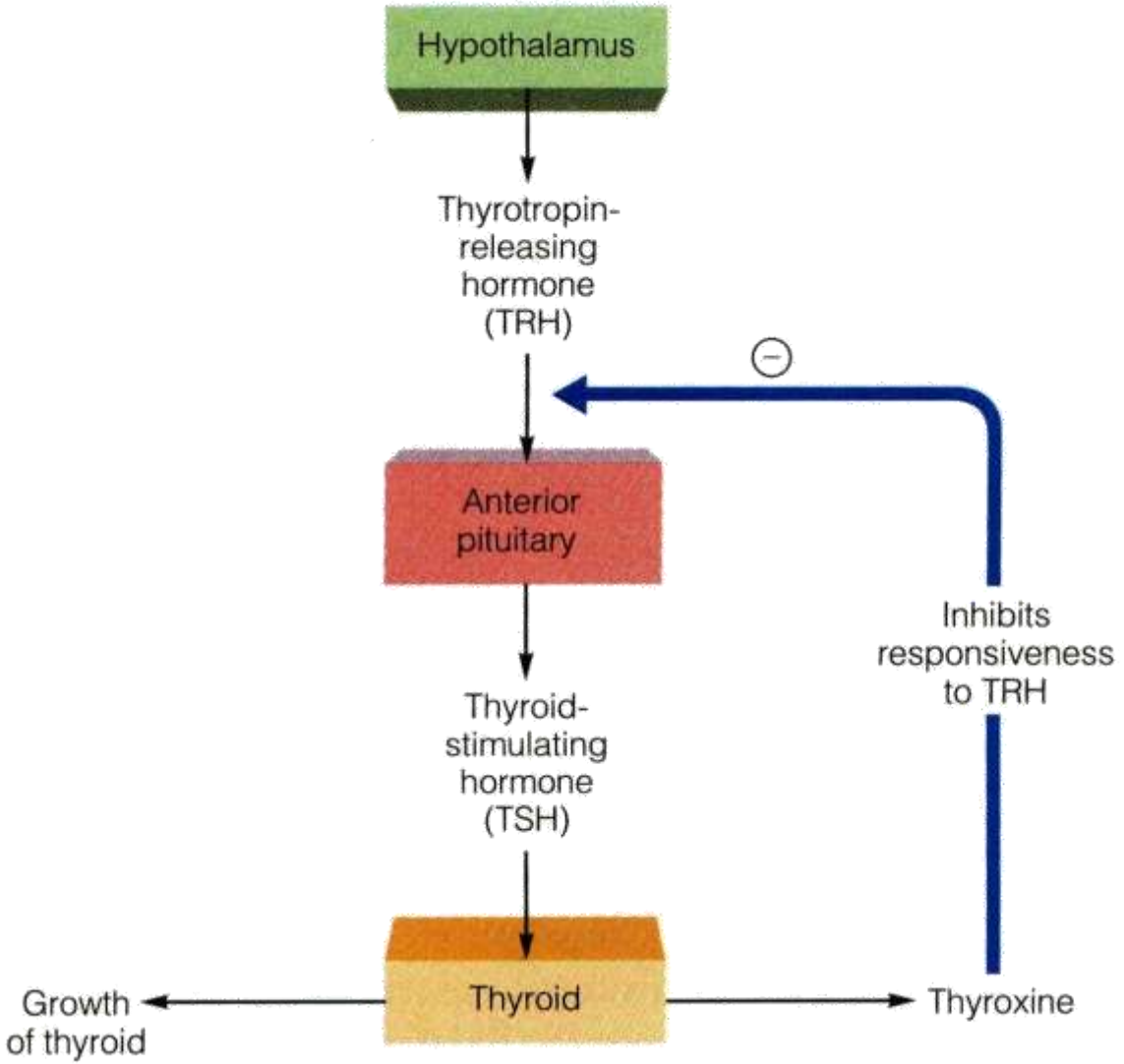
1. Effectory
2. Tropic
3. Neuroregulatory (liberins & statins)

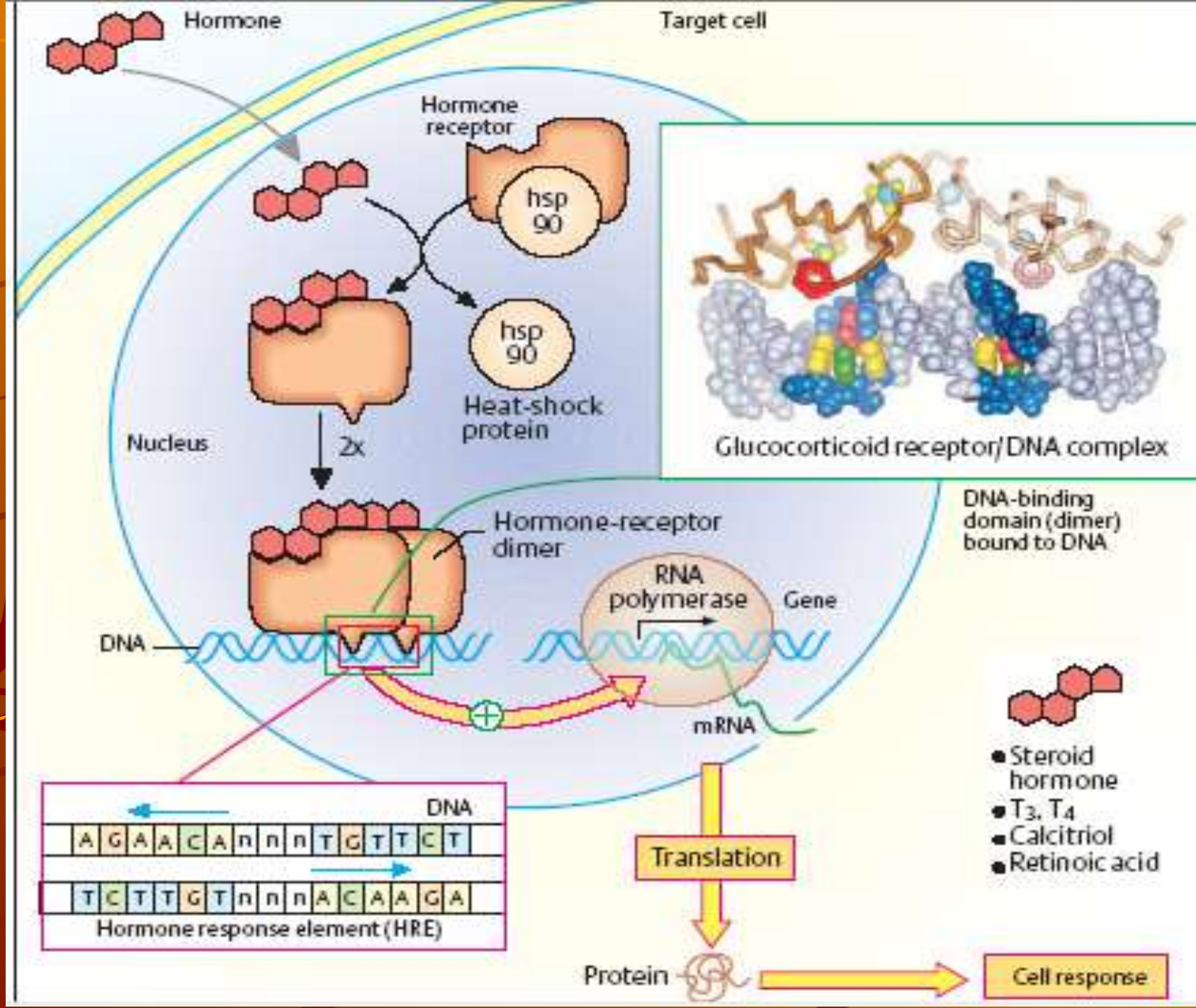

Hormone
Receptor
Cell membrane
Adenylate cyclase
ATP
Cyclic AMP
Phosphodiesterase
5'AMP
Protein kinase (inactive)
Inhibitory subunit
Protein kinase (active)
Hormone effects

SEQUENCE OF EVENTS INVOLVING CYCLIC AMP AS A SECOND MESSENGER

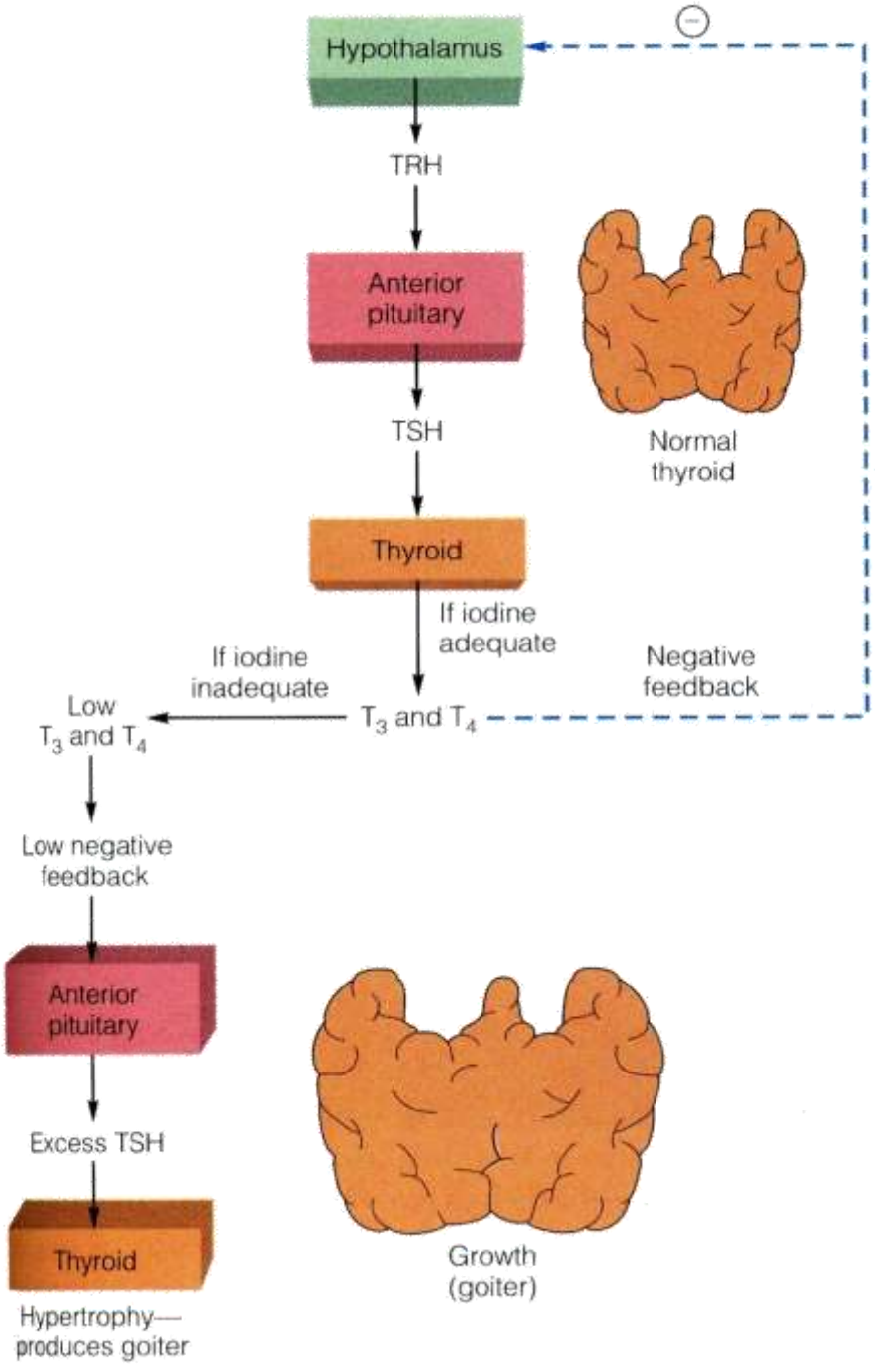
1. The hormones combine with their receptors on the outer surface of target cell membranes.
2. Activation of adenylate cyclase on the cytoplasmic side of the membranes.
3. Conversion of ATP to cyclic AMP (cAMP) within the cytoplasm.
4. cAMP activates protein kinase.
5. Protein kinase phosphorylates enzymes.
6. The activity of specific enzymes is either increased or inhibited by phosphorylation.
7. Changes in cell metabolism, permeability or functions.

Regulation of hormone secretion by the level of effectory hormones in blood

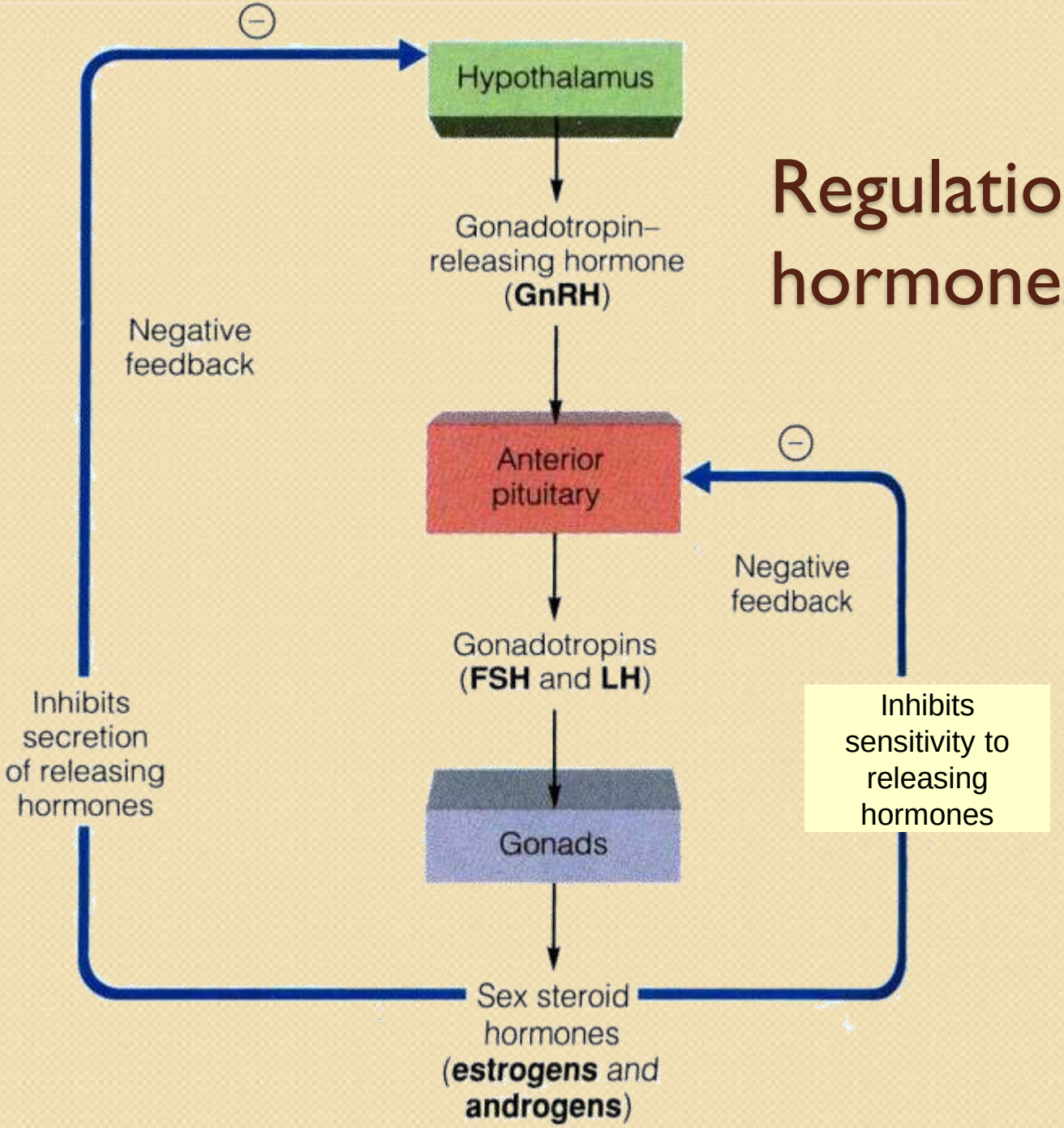


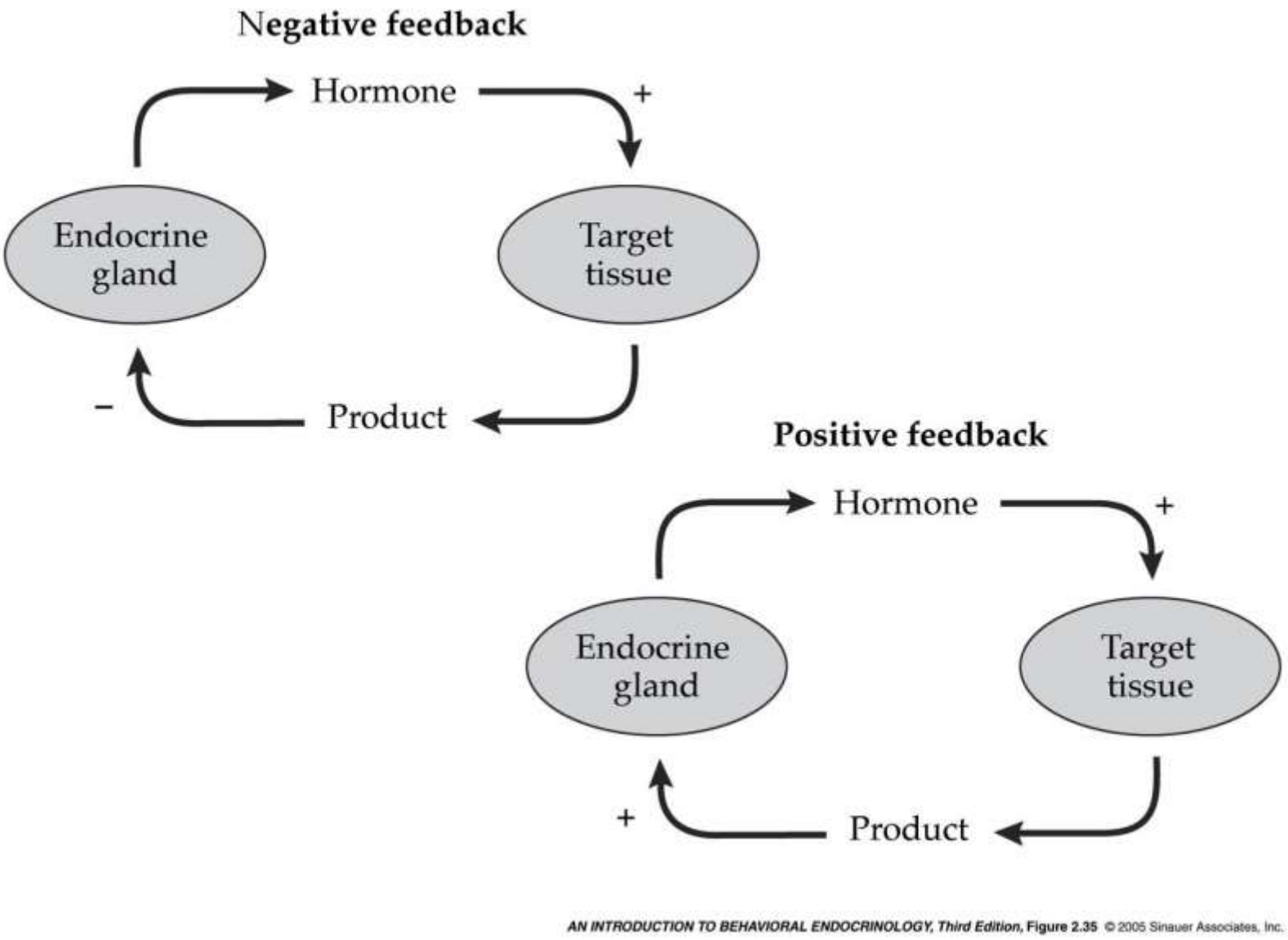

Hormone
Target cell
Hormone receptor
hsp 90
hsp 90
Heat-shock protein
Nucleus
2x
Glucocorticoid receptor/DNA complex
DNA-binding domain (dimer) bound to DNA
Hormone-receptor dimer
RNA polymerase
Gene
DNA
mRNA
DNA
A G A A C A n n n T G T T C T
T C T T G T n n n A C A A G A
Hormone response element (HRE)
Translation
Protein
Cell response
Steroid hormone
T3, T4
Calcitriol
Retinoic acid

Regulation of thyroid hormones secretion

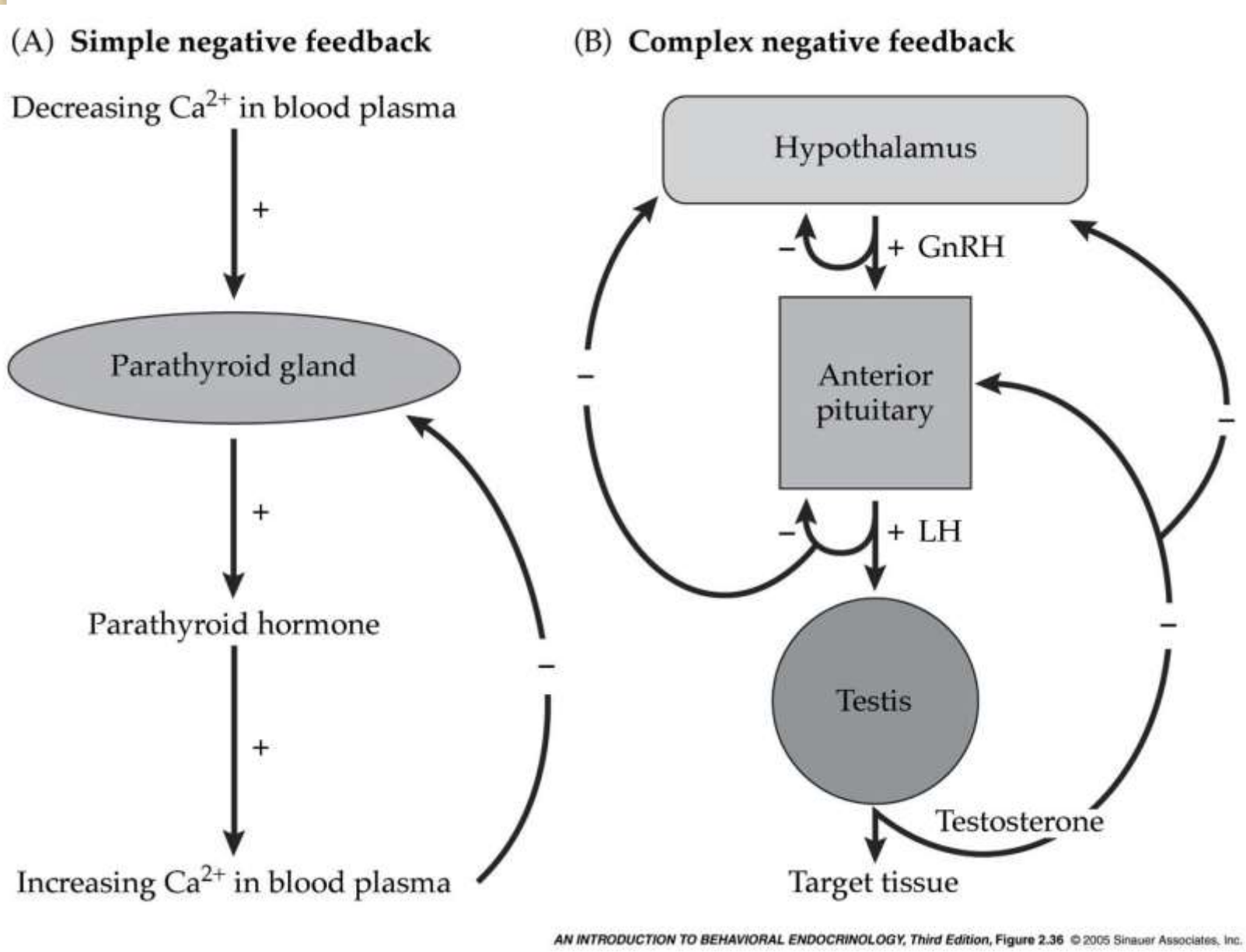


Regulation of sex hormones secretion





AN INTRODUCTION TO BEHAVIORAL ENDOCRINOLOGY, Third Edition, **Figure 2.35**



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