

REGULATION

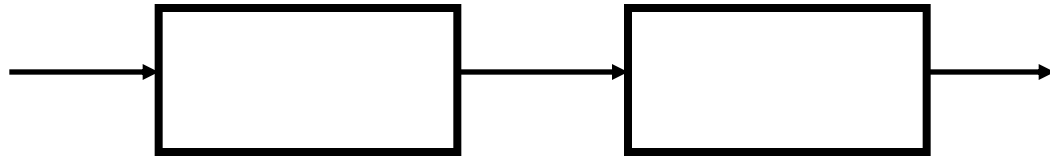
Control of living systems.

Living systems – open systems; their existence depends on flow of energy and substances between organism and environment in both directions.

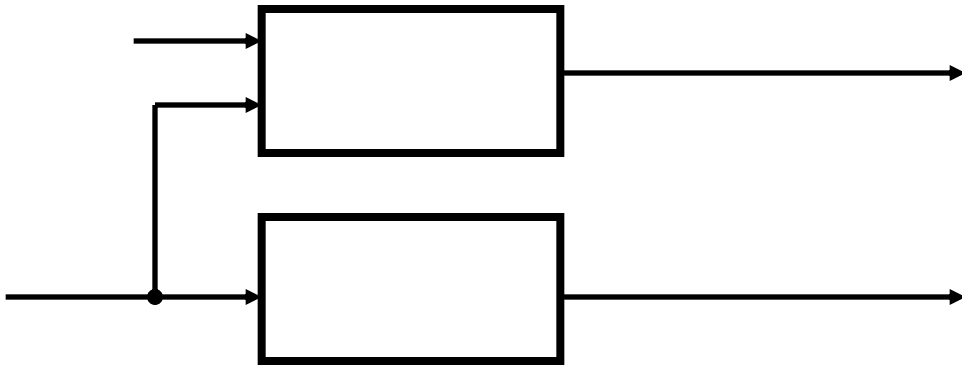
Appears at all levels of the system (from cell – to the whole organism).

BASIC TYPES OF FEEDBACK

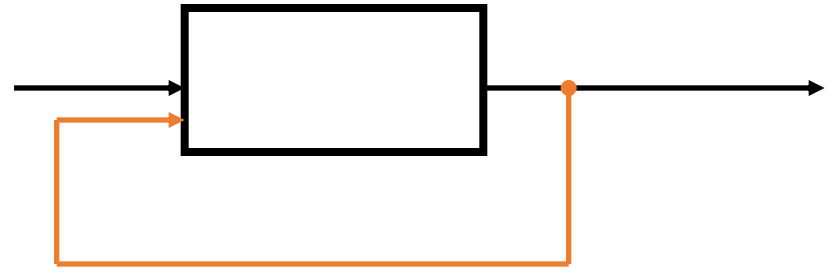
SERIAL



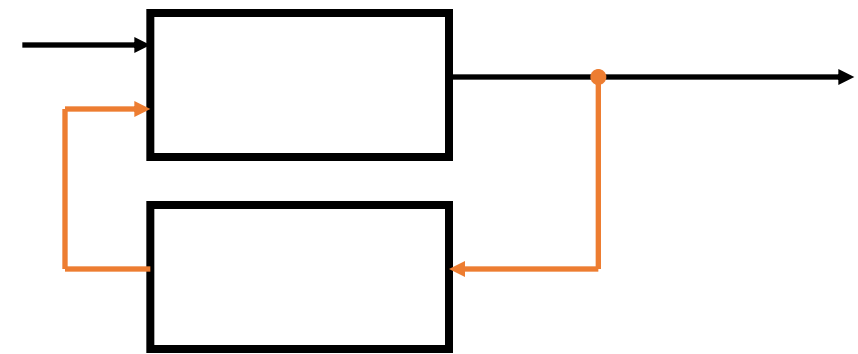
PARALLEL

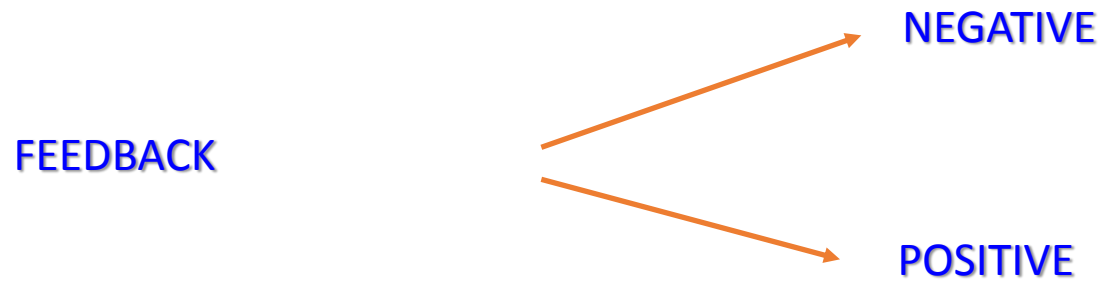


NEGATIVE DIRECT



NEGATIVE INDIRECT



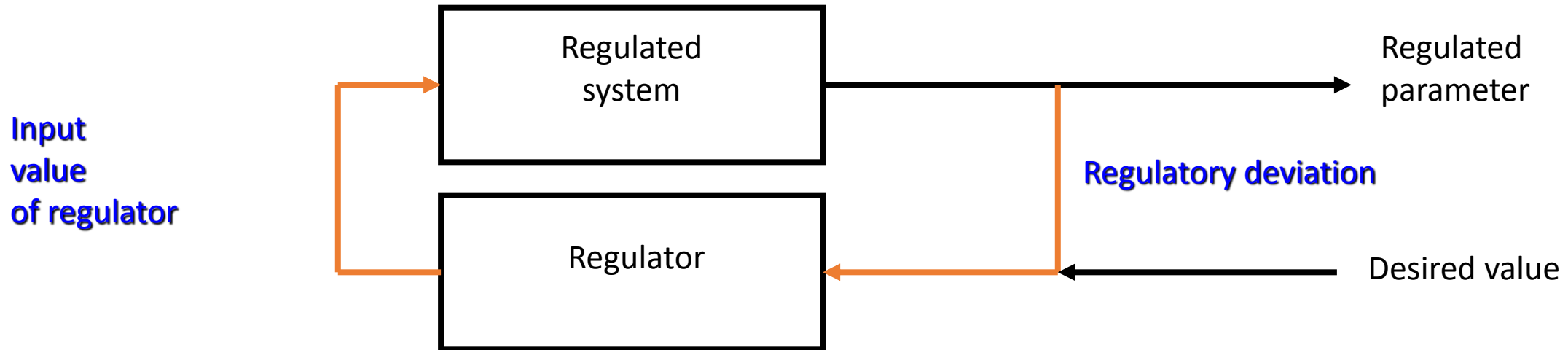


Deviation oscillates or continuously increases.



NEGATIVE FEEDBACK

- plays a role in regulations
- compensates the difference of regulated parameter
- minimizes the difference between real values of regulated parameter and so-called **desired value**



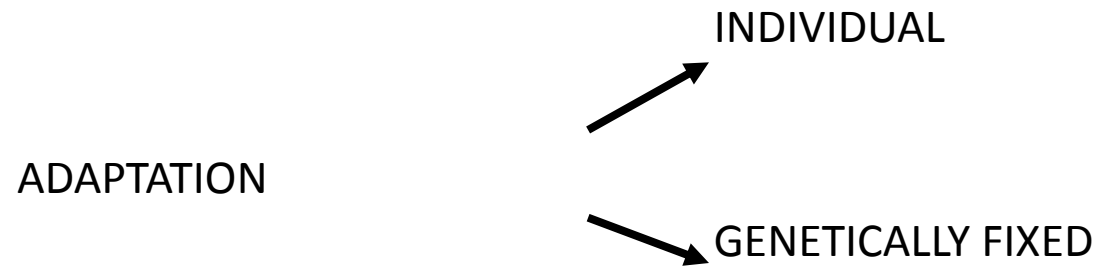
POSITIVE FEEDBACK

- No regulatory effect
- It does not compensate the deviation, but amplifies it

REACTION (REGULATION): direct, immediate response of organism on environmental changes

ADAPTATION = a complex of biochemical, functional and structural changes in organism caused by long-lasting and repeated environmental changes

REACTION (sec, min) vs. **ADAPTATION** (min, hours, days)



MECHANISMS OF ADAPTATION

= processes which lead to new, functionally better parameters.

Aim is to reach new, more advantageous qualities for surviving of the individual or species.

DURATION OF ADAPTATION:

Minutes - years

PARAMETER	REST	EXERCISE	INCREASE (x)
Cardiac output (l/min)	5-6	25 (35)	4-5 <i>Heart reserve</i>
Heart rate (t/min)	70	210 (250-190) <i>depends on age</i>	3 <i>Frequency reserve</i>
Stroke volume (ml)	75	115	1,5 <i>Volume reserve</i>
Systolic BP (mmHg)	120	↑ ?	-
Diastolic BP (mmHg)	70	↓ ↑ — ?	-
Pulse BP (mmHg)	50	70-100	1,5-2
Mean BP (mmHg)	-	-	small increase
Muscle perfusion (ml/min/100g)	2-4	60-120	30 (10% MV _{max})

PARAMETER	REST	EXERCISE	INCREASE (x)
Minute ventilation (l/min)	6-12	90-120	15-20
Respiratory frequency (d/min)	12-16	40-60	4-5
Tidal volume (ml)	0,5-0,75	2	3-4
Blood flow (l/min)	5,5	20 – 35	4-6
O₂ intake (ml/min) - V_{O₂}	250-300	3000	10-12
Total CO₂ (ml/min)	200	8000	40
pO₂ (Torr)	40	25	
O₂ extraction (%)	+	+	++

VESICULAR FOLLICLE

PRIMARY FOLLICLE - FSH

Growth acceleration of primary follicle – change into vesicular follicle:

1) estrogens released into follicle stimulate granul. cells



increased number of receptors for FSH – POSITIVE FEEDBACK

(higher sensitivity for FSH!!!)

2) Increased number of receptors for LH (estrogens and FSH) – another acceleration of growth due to „higher sensitivity“ to LH

3) Increased estrogens and LH secretion accelerates growth of theca cells, secretion is increased

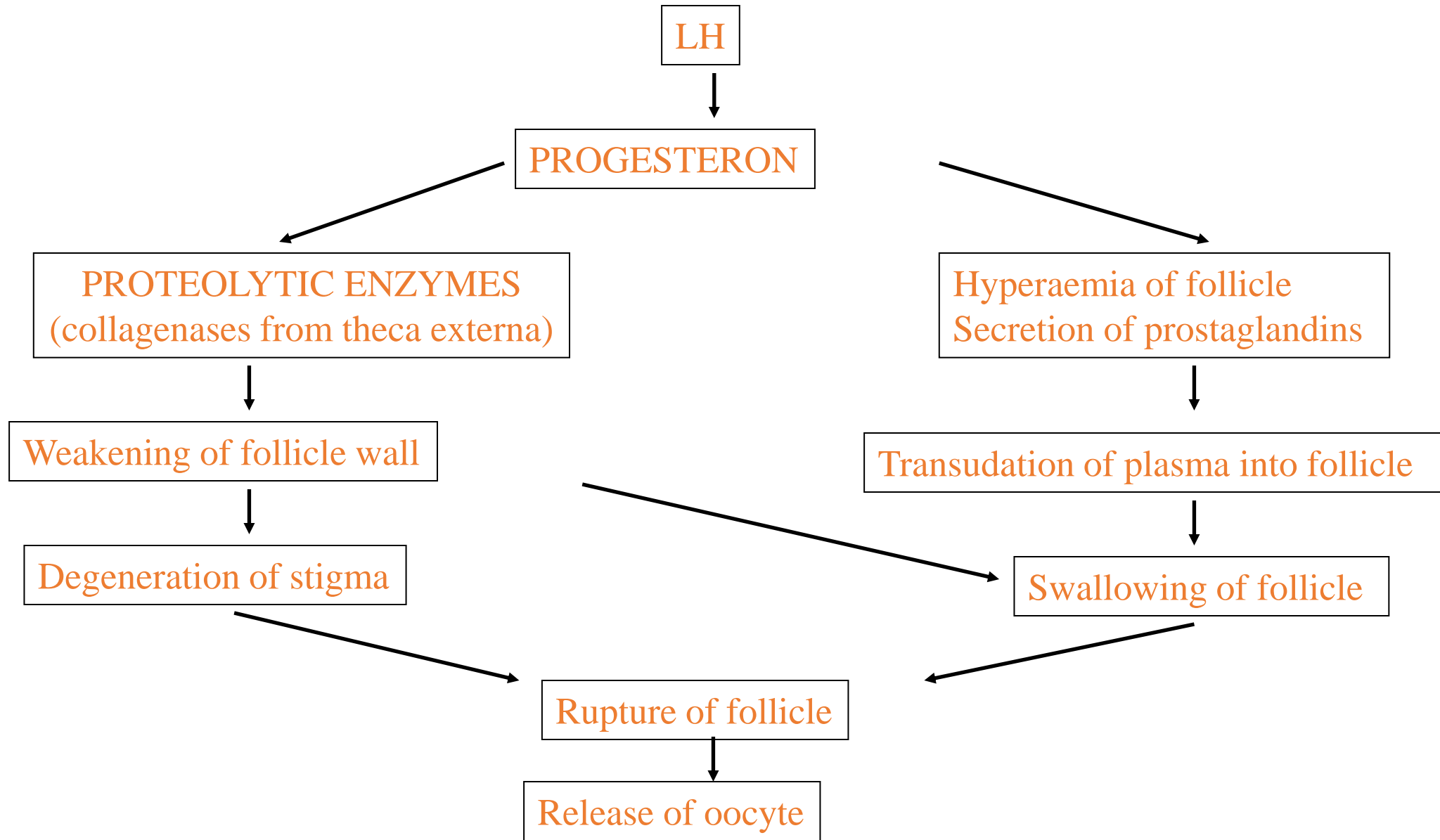
explosive growth of follicle



DOMINANT FOLLICLE

1. High level of **estrogens** from the fastest-growing follicle
2. **Negative** feedback on FSH production from adenohypophysis
3. Drop in **FSH** secretion
4. „**Dominant** follicle“ continues in growing due to **intrinsic positive** feedback
5. Other follicles grow slowly and subsequently become **atretic**

MECHANISM OF OVULATION



FEELING OF HUNGER

LACK OF FOOD

Hungry
contractions of
stomach

Decreased
glucose
availability

Decreased heat
production

Changes of lipid
metabolism

Mechanoreceptors

Glucoreceptors

Internal thermoreceptors
(hypothalamus)

„Liporeceptors“

HUNGER

SHORT-TERMED REGULATION

LONG-TERMED REGULATION

Compensation of dietary mistakes

FEELING OF SATIETY

FOOD INTAKE

Chewing movements

Receptors in nose, mouth, oesophagus, intestine

Mechanoreceptors of stomach

GIT chemoreceptors

Central glucothermo-lipo-receptors

COMPILING THE INFORMATION IN CNS
(ventromedial hypothalamus)

PRERESORPTIVE FEEDING

SATIETY

RESORPTIVE FEEDING

FOOD INTAKE REGULATION

HYPOTHESIS:

1. Lipostatic
2. H. of intestinal peptides
3. Glucostatic
4. Thermostatic

ADIPOSE TISSUE

LOSS OF BODY MASS

- LEPTIN

HYPOTHALAMUS

NPY

NPY RECEPTOR

RESPONSE TO FASTING

- + Food intake
- Reproduction
- Temperature
- Energy expenditure

PARASYMPATHETIC ACTIVITY

MCH
OREXIN A, B

INCREASE OF BODY MASS

+LEPTIN

HYPOTHALAMUS

MSH

MSH RECEPTOR

POMC derivatives

RESPONSE TO OBESITY

- Food intake
- + Energy expenditure

SYMPATHETIC ACTIVITY