

- The GIT is a tube, specialized along its length for the sequential processing of food
- Assimilation of substrates from food requires both digestion and absorption
- Digestion requires enzymes, which are secreted in various parts of GIT
- Food ingestion triggers complex whole-body responses (endocrine, neural, paracrine)
- GIT plays an important role also in homeostasis (absorption vs. excretion, izovolemia, izoionia, etc.) and immunity

GASTROINTESTINAL TRACT

Mechanical and chemical processing of food

Absorption and excretion of products

Protection of internal environment (toxins, microbes...)

Motility, secretion, digestion, absorption, storing, excretion

GIT motility – mainly nervous control

Secretion in GIT – mainly humoral control

Transport mechanisms, liver function

+

PARASYMPATICUS

(preganglionic cholinergic fibres)
n.VII, n.IX, n.X, nn.pelvici (S2-S4)

-

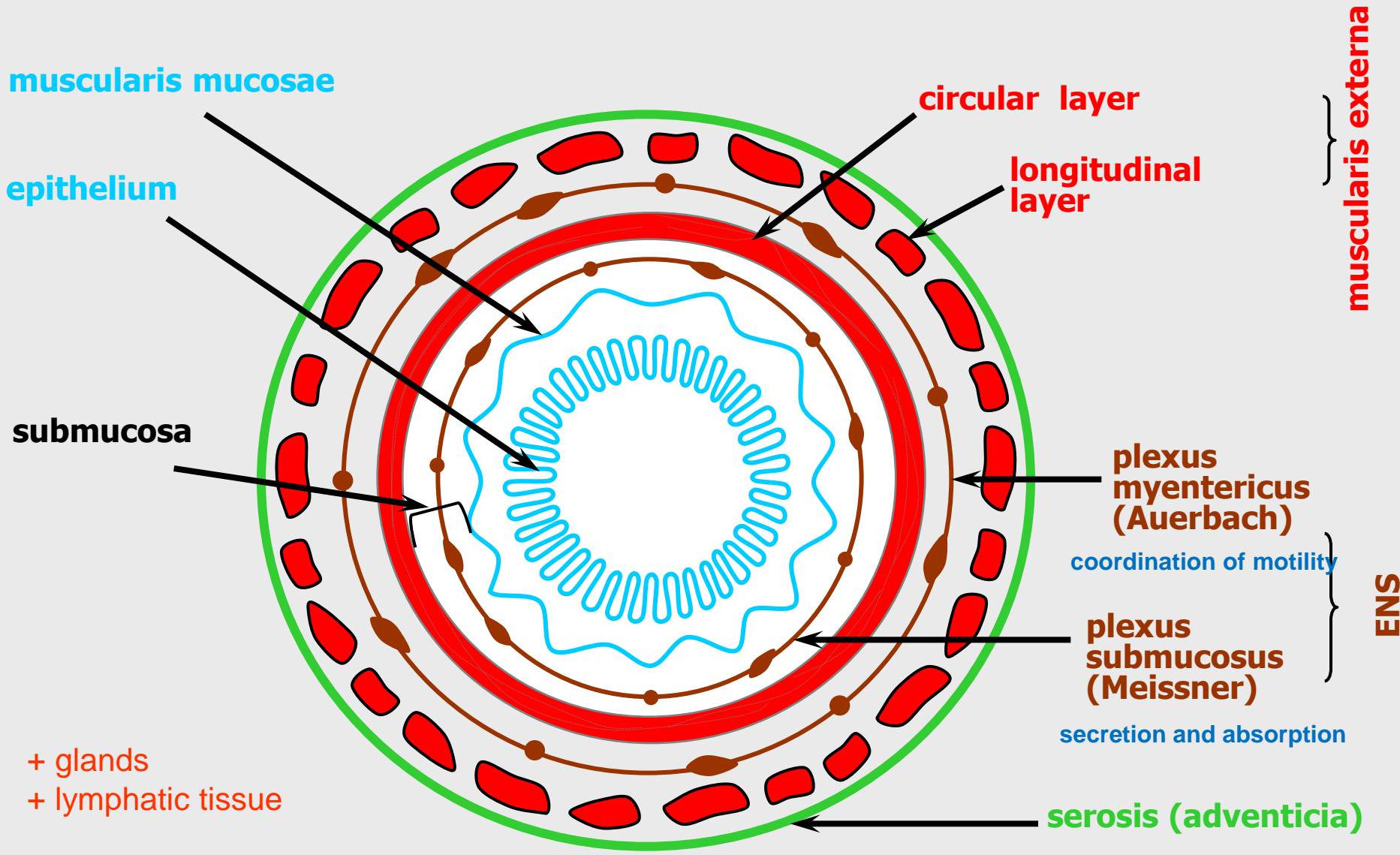
SYMPATICUS

(postganglionic adrenergic fibres)
Th5-L2

(tonus and motility -)

(vasoconstriction)

(musc.mucosae, sphincters +)



Circular muscle layer: inhibitory fibers, contraction – gut is longer and smaller in diameter
Longitudinal muscle layer : no inhibitory fibers, contraction – gut is shorter and bigger in diameter

ENTERIC NERVOUS SYSTEM

(plexuses + endings of sympathetic and parasympathetic nervous system + other GIT neurons)

Control of:

- GIT motility
- GIT secretion
- GIT vasomotor control

Chemoreceptors, mechanoreceptors, thermoreceptors...
(mucosa, musc. externa)

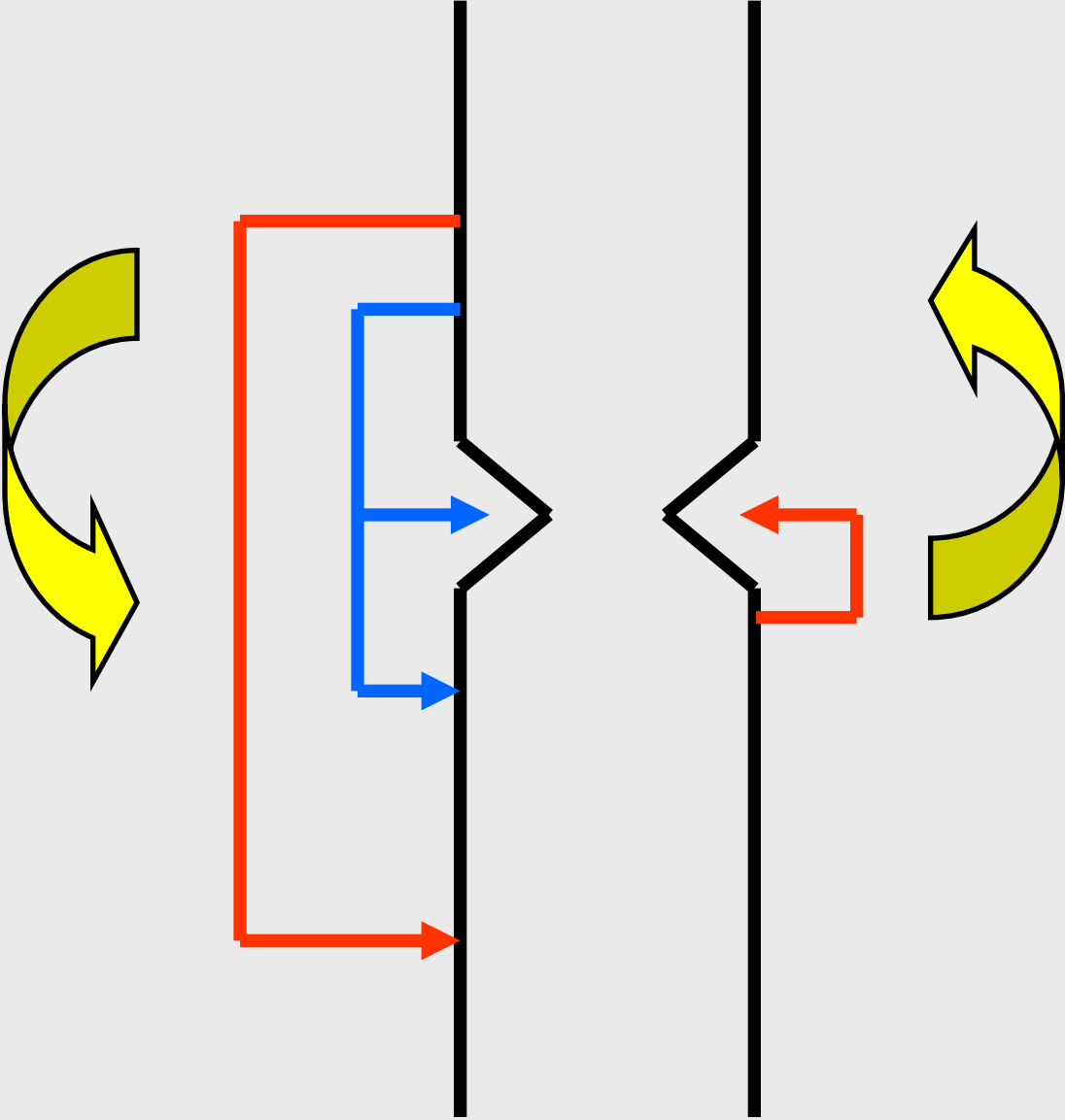
Mediators and modulators: Ach, peptides and bioactive amines

Ach, VIP, NOR, DOPA, serotonin, histamine, AT II, PG
somatostatin, enkephalin, GABA, TRH, neuropeptide Y, substance P
secretin, GIP, glucagon, gastrin, CCK, G-releasing peptide
(Secretin group)
(Gastrin group)

Local (short) reflexes

Central reflexes

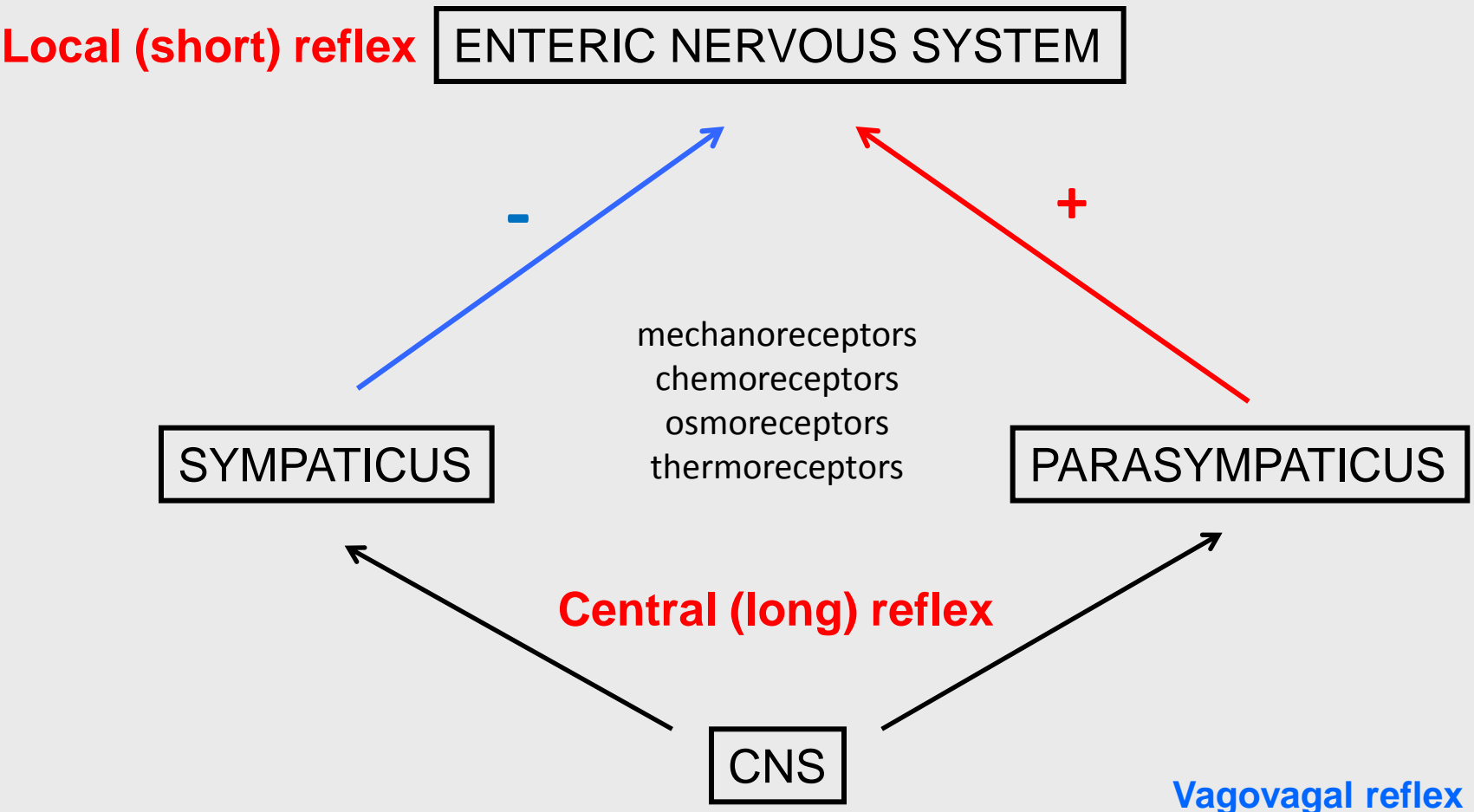
Continuous tonus of
S, PS



FORWARD SIGNALS : SPEED UP, OPEN THE WAY

BACKWARD SIGNALS: SLOW DOWN, CLOSE THE WAY

GIT INNervation



ELECTROPHYSIOLOGY OF GI SMOOTH MUSCLE

Resting potential:

from -40 to -80mV (\uparrow gNa : \downarrow gK)

Lower activity of Na⁺/K⁺-ATPase

Slow waves (oscillation of rest.MP)

3 (stom.) – 12(duod.)/min – **basal electric rhythm**

Spike (AP)

low voltage, depolarisation – Na⁺ and Ca²⁺, 1-10/sec
automacy

Pacemaker cells in ENS

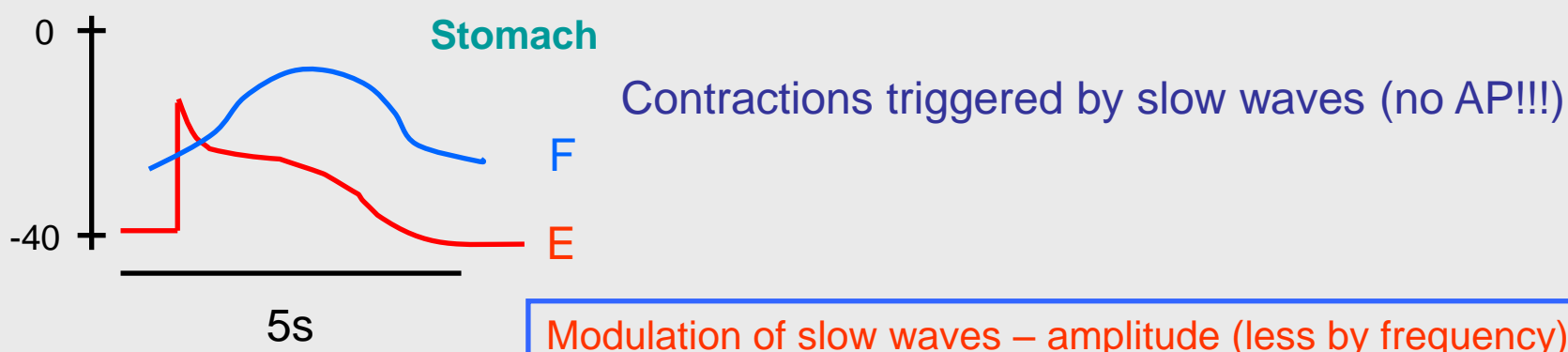
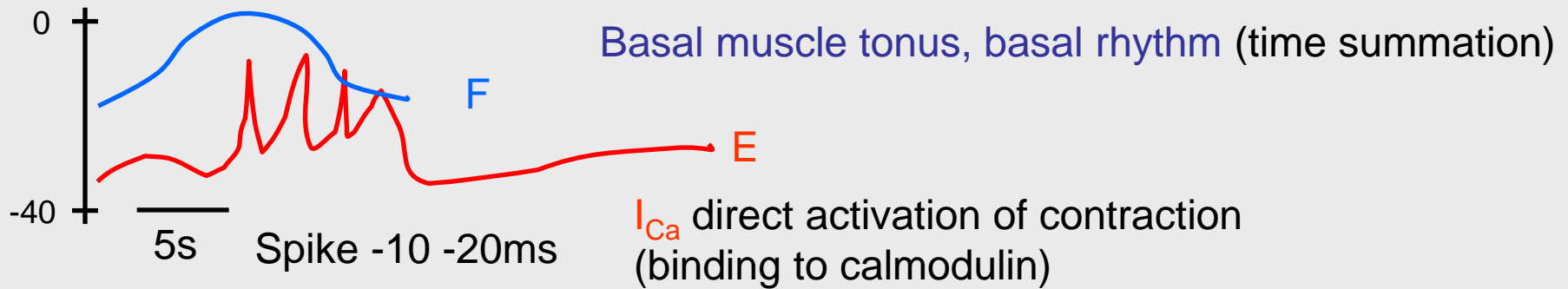
neurohumoural regulation

Variability

Innervations: nexus, innervations of circular muscle >> longitudinal muscle

No motor endplate

Ach, ENS, exceptions



Modulation of slow waves – amplitude (less by frequency)

GIT MOTILITY

CONTRACTIONS

tonic (stomach, colon)

rhythmic

MOVEMENTS

propulsive (peristalsis, myenteric reflex)

mixing

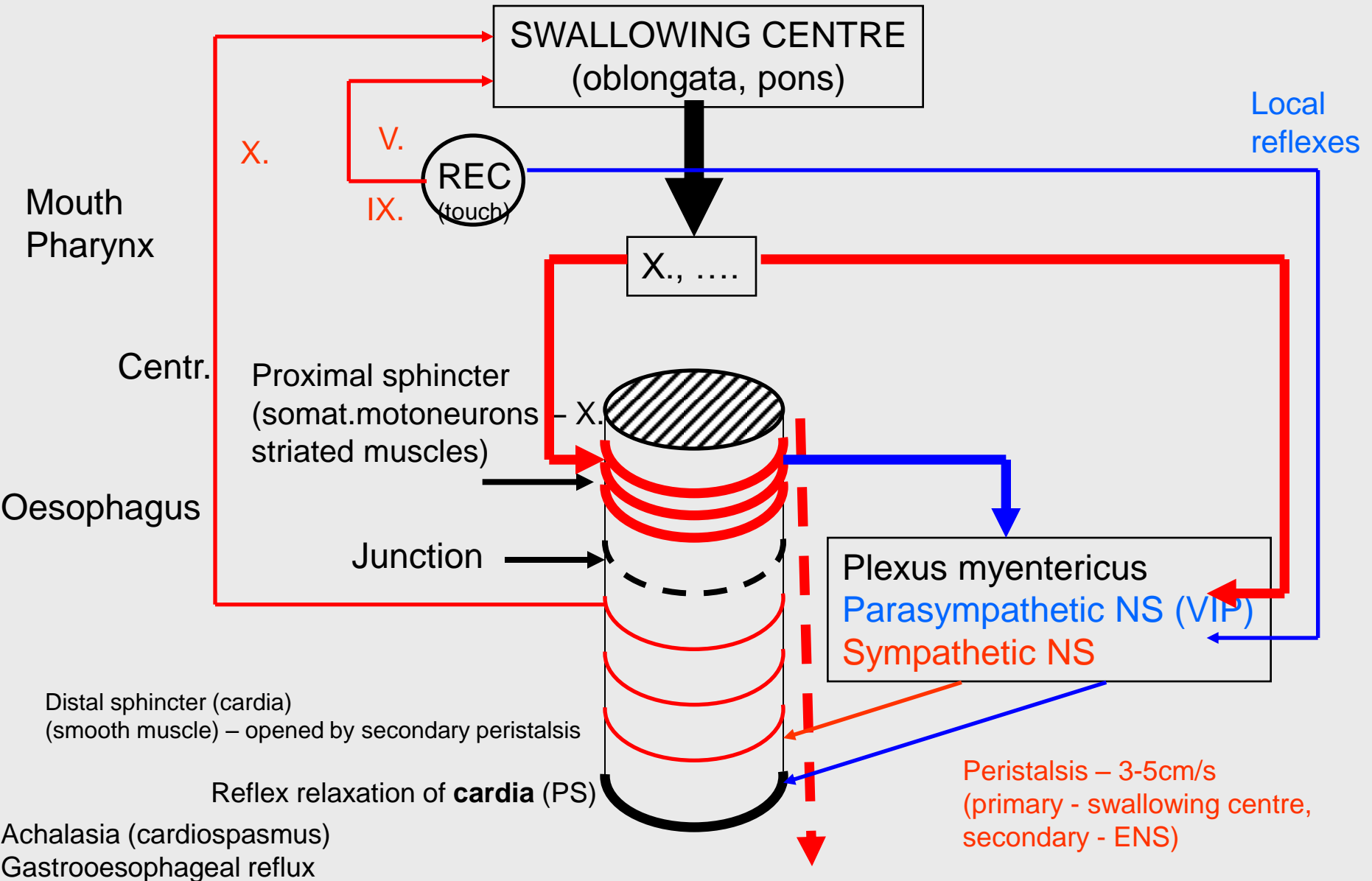
Receptive relaxation.

These contractions and movements are responsible for churning, peristalsis and reservoir action in GIT.

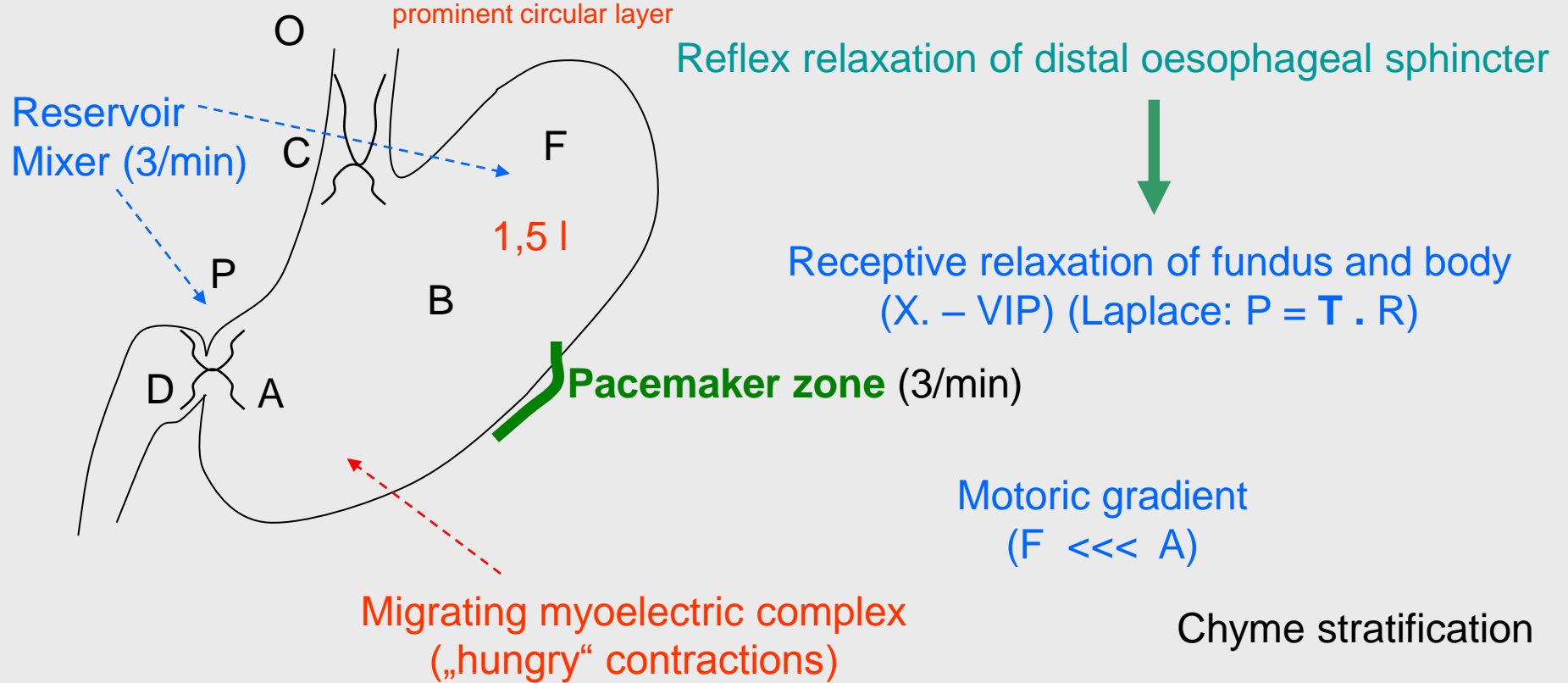
SWALLOWING

- **Oral** phase (voluntary)
- **Pharyngeal** phase (reflex) < 1s
- **Oesophageal** phase (peristaltic)

Food – chewing (voluntary and reflex)
 Saliva (1.5 litres / day)
 Frequency of swallowing – approx. 600x / day



GASTRIC MOTILITY



1-2 hour: rest

10-20 min: activity, during fasting is stronger

PYLORUS = sphincter ???

Common ENS with bulbus duodeni

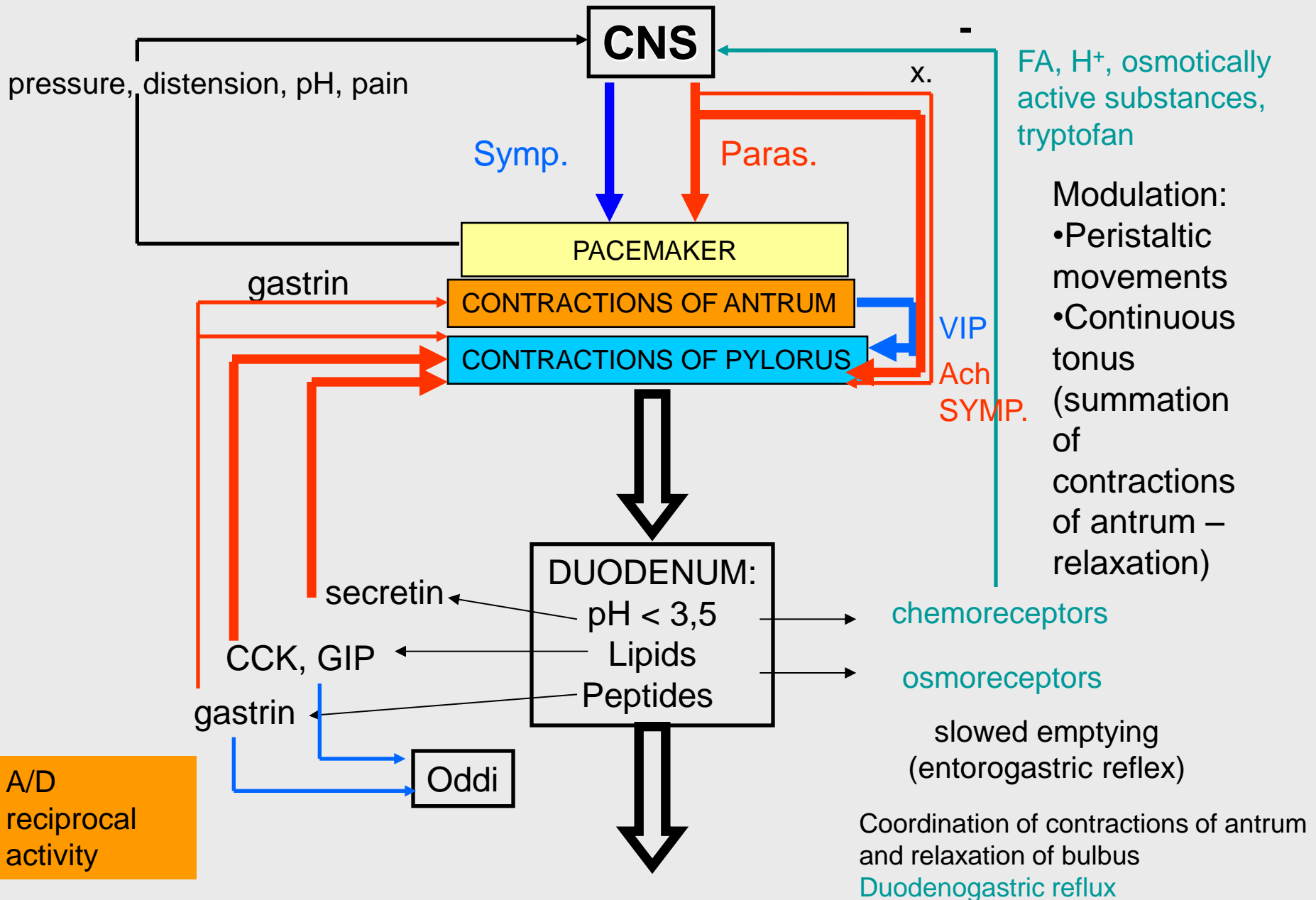
Smooth muscle

sympaticus +++, n.X. --- (VIP)

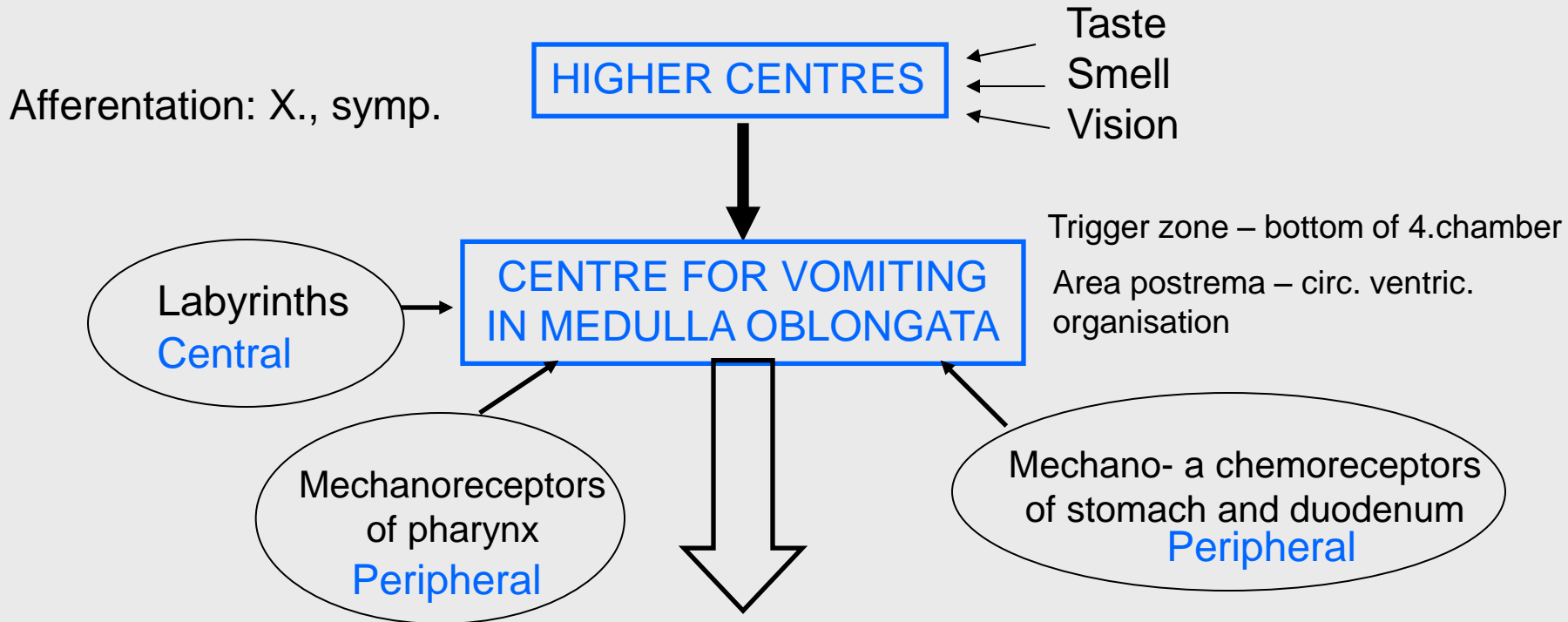
N. vagus +

Plexus cealicus -

EMPTYING OF STOMACH



VOMITING (PROTECTION)



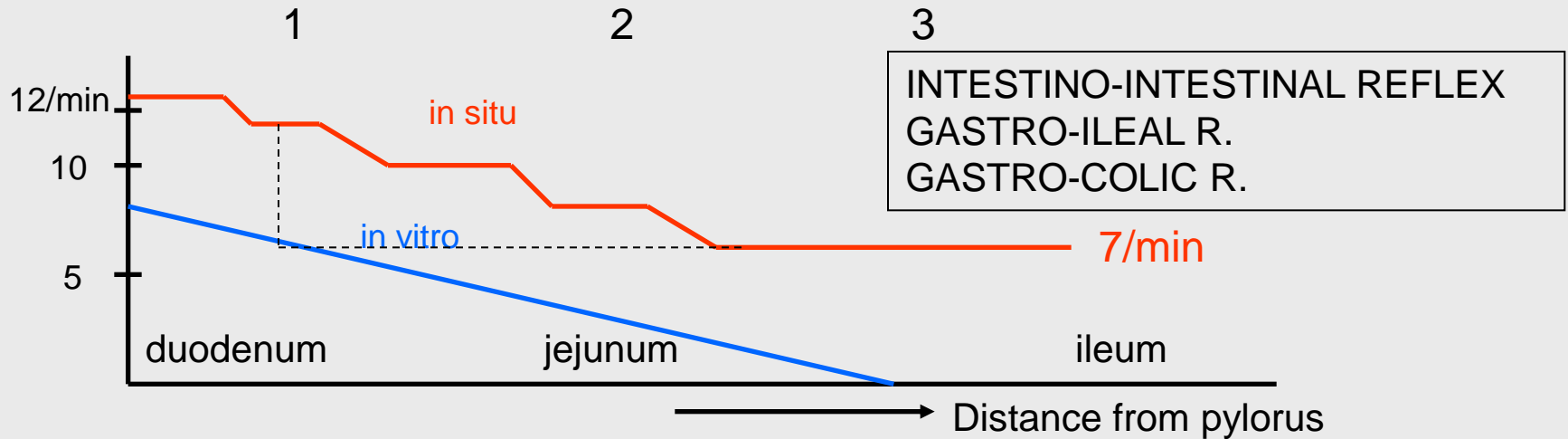
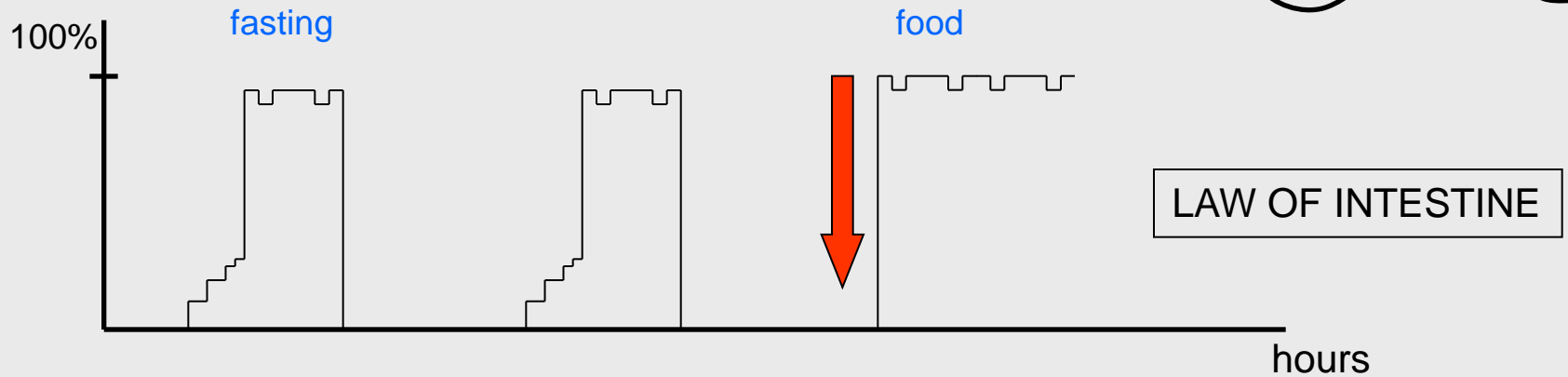
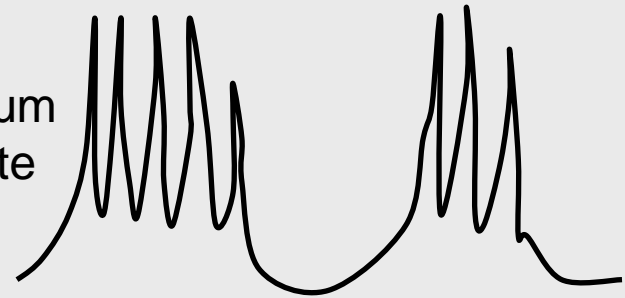
- Antiperistalsis in jejunum and duodenum
- Relaxation of pylorus and antrum
- Contractions of diaphragm (increased intraabdominal pressure)
- Inverse Valsalva manoeuvre (decreased intrathoracal pressure)
- Contractions of pylorus and antrum
- Relaxation of cardia
- Relaxation of upper pharyngeal sphincter

Emetics: central
peripheral

Antiemetics

MOTILITY OF SMALL INTESTINE

- Slow waves – approx. 11-13/min in duodenum, 8-9 - ileum
- „Minute“ rhythm (jejunum) – salvos approx. every minute
- Hour rhythm (migrating myoelectric complex)

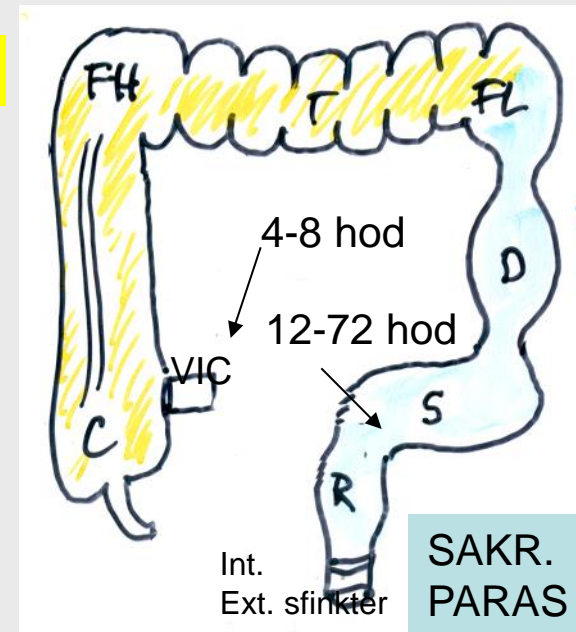


Segmentation >>> peristalsis (up to 10 cm)

MOTILITY OF COLON

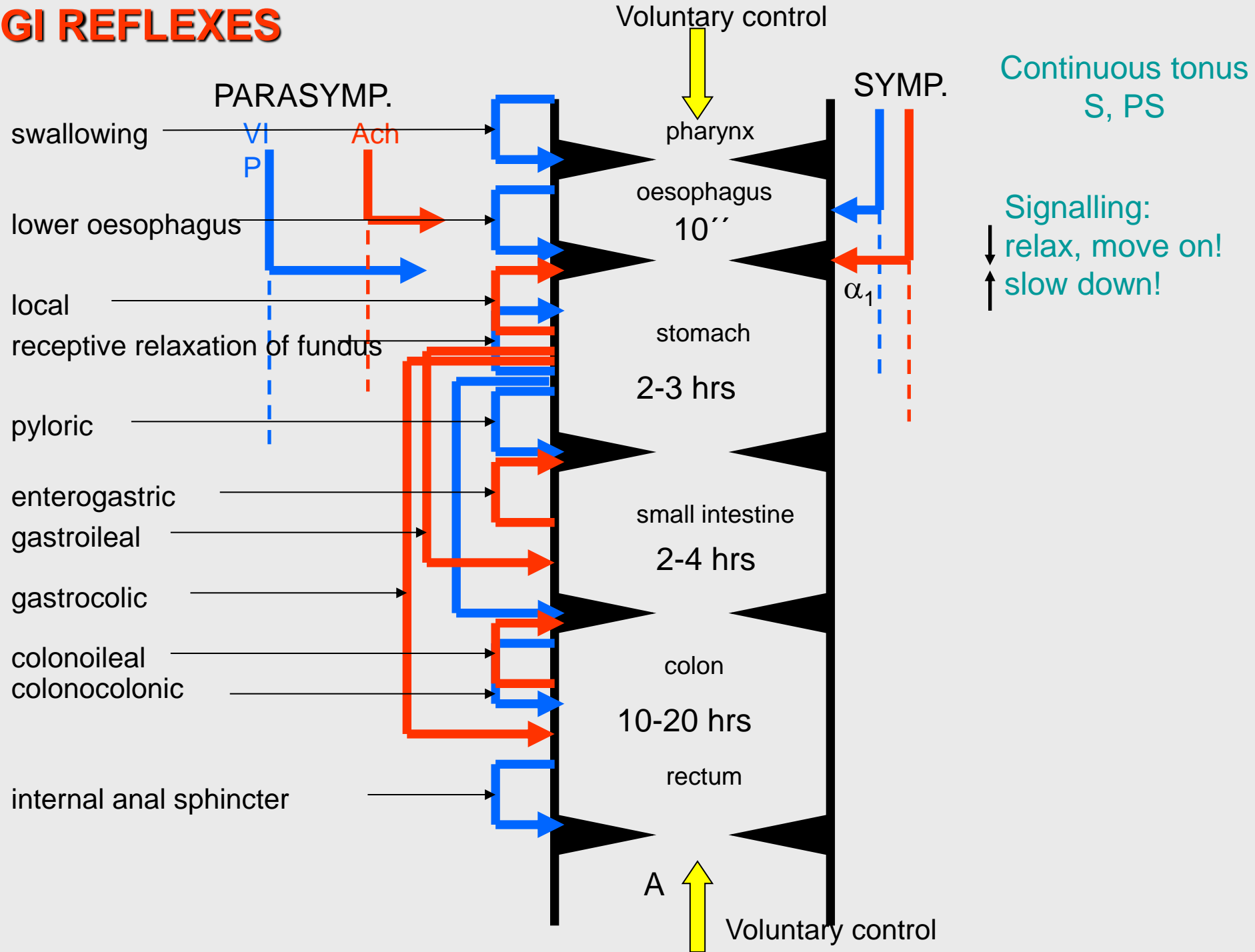
- Slow waves with frequency 4 – 6 / min
- Segmentation = **haustra**; 5-10 cm/hour – **pendulum movements**
- **Mass peristalsis**; 1-3/day – „sweeping“
- Reverse peristalsis – in proximal colon („delay“ – absorption of water and ions)
- Control of anal sphincter: int. – reflex, ext. – voluntary (+reflex)
- Defecation: abdominal muscles +++, muscles of pelvic bottom –
- Reflex: colono-colonic, gastro-colic

PS



- Parasympathicus + (X. till FL)
- Sympathicus – (L2 – L4)

GI REFLEXES



GI REFLEXES

Superposed on basal tonus

PS and S (sphincters S PS)

R. lower oesophagus

Pyloric r. (X.)
PS and S

Enterogastric r.
(chemoreceptors)

Reciprocal
function of long.
and circ. muscle

Innervations of only circ. muscle

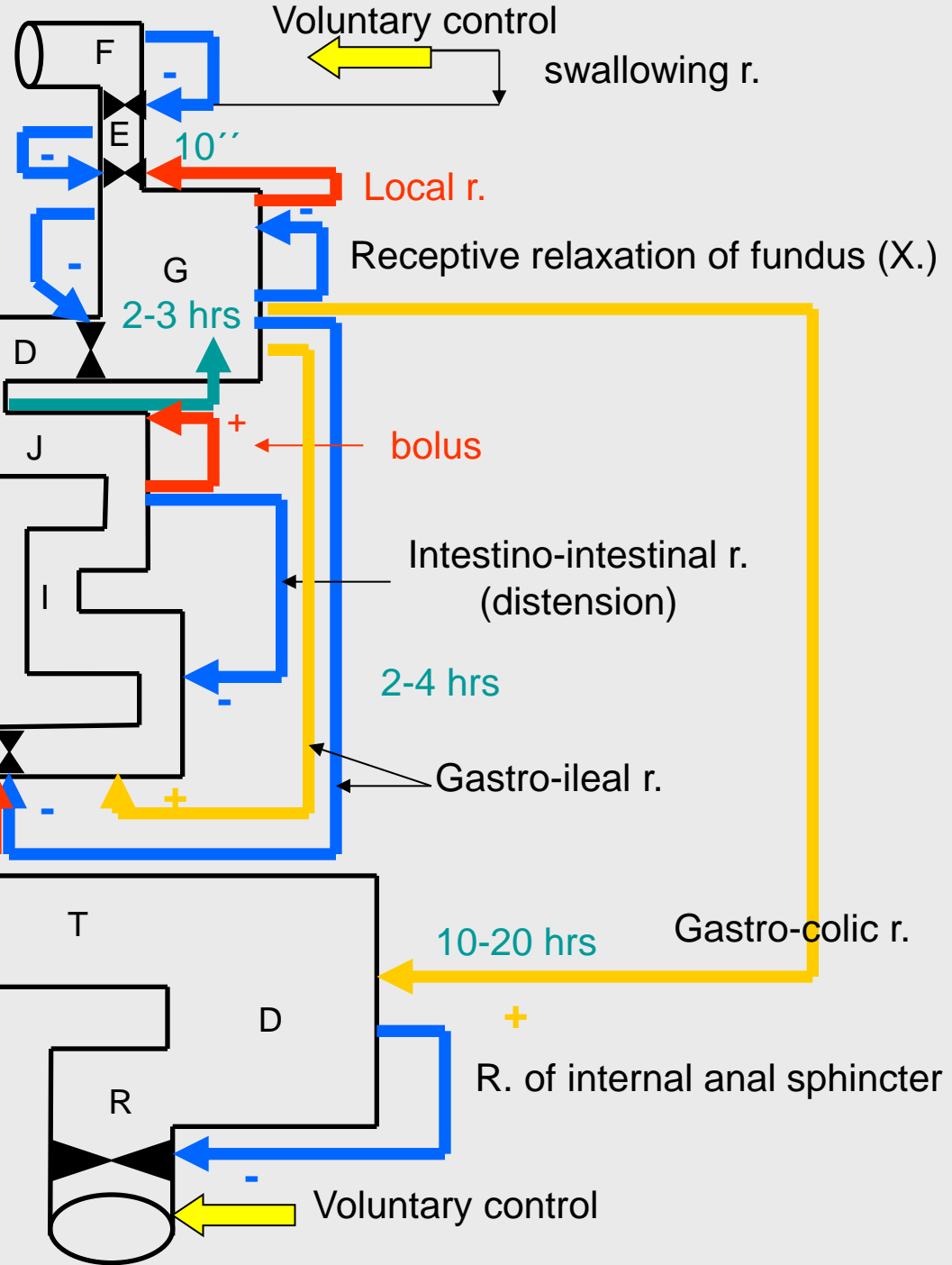
Motility is increased:

- CCK
- Substance P
- Gastrin

Colono-ileal r. (+)

Colono-colonic r.

- Mass peristaltic movements
- Haustra, segmentation
- Reverse peristalsis



Voluntary control
swallowing r.

Local r.

Receptive relaxation of fundus (X.)

bolus

Intestino-intestinal r.
(distension)

2-4 hrs

Gastro-ileal r.

10-20 hrs
Gastro-colic r.

R. of internal anal sphincter

Voluntary control