

GASTROINTESTINAL TRACT

Mechanical and chemical processing of food

Absorption and excretion of products

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

GIT motility – nervous control

Secretion in GIT – humoural control

Transport mechanisms, liver function

Motility, secretion, digestion, absorption

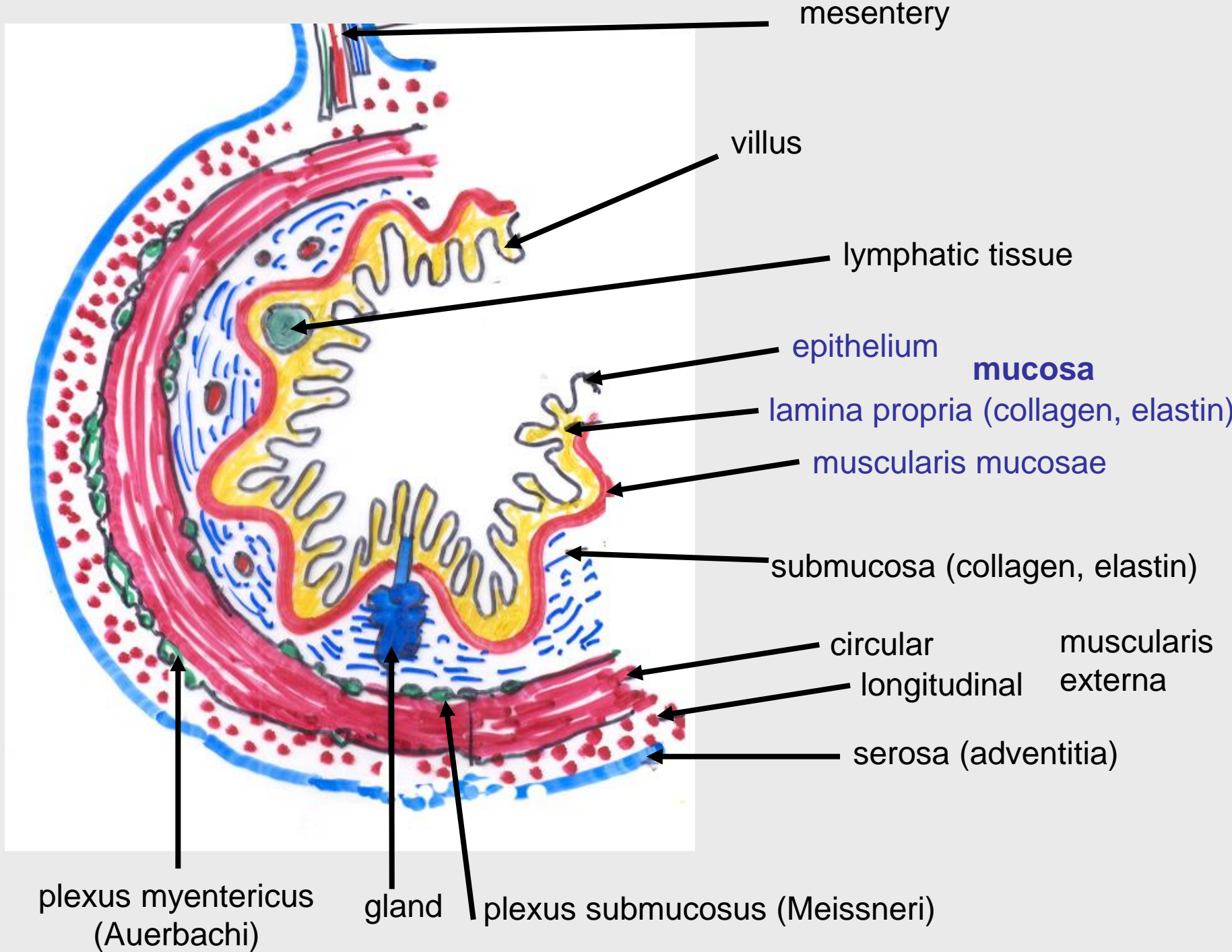
+

PARASYMPATICUS
(preganglionic cholinergic fibres)

-

SYMPATICUS
(postganglionic adrenergic fibres)

(tonus and motility -)
(vasoconstriction)
(musc.mucosae, sphincters +)



mesentery

villus

lymphatic tissue

epithelium

mucosa

lamina propria (collagen, elastin)

muscularis mucosae

submucosa (collagen, elastin)

circular

muscularis

longitudinal

externa

serosa (adventitia)

plexus myentericus (Auerbachi)

gland

plexus submucosus (Meissneri)

ENTERIC NERVOUS SYSTEM

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

Cells:

- ganglionic
- sensory
- motoric
- pacemaker

Local reflexes

Control of:

- GIT motility
- GIT secretion
- GIT vasomotor control

Central reflexes

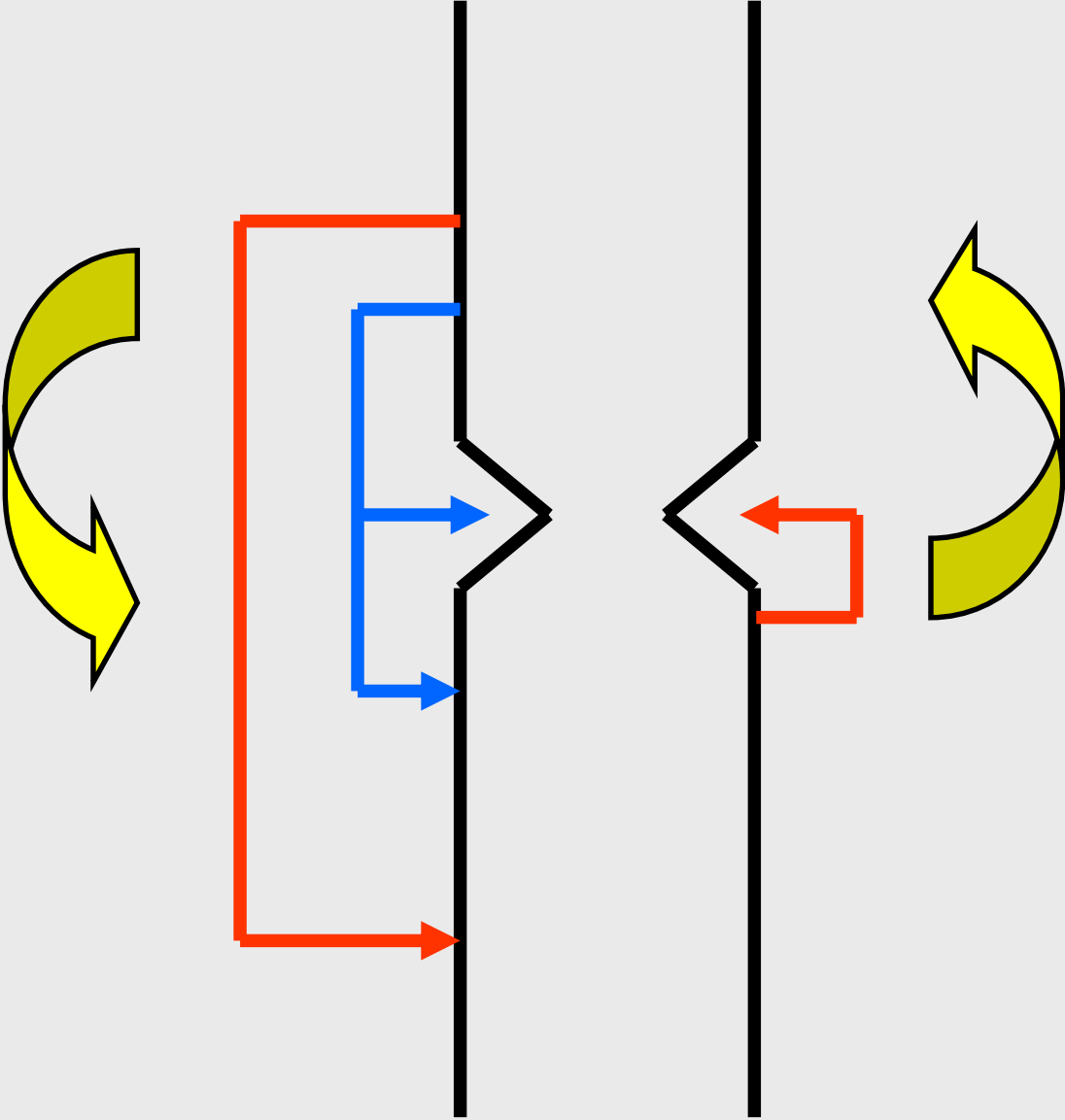
Chemoreceptors, mechanoreceptors, thermoreceptors...
(mucosa, musc. externa)

Mediators and modulators:

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)

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

Continuous tonus of
S, PS



FORWARD SIGNALS : SPEED UP, OPEN THE WAY

BACKWARD SIGNALS: SLOW DOWN, CLOSE THE WAY

ELECTROPHYSIOLOGY OF GI SMOOTH MUSCLE

Resting potential:

from -40 to -80mV (↑ gNa : ↓ 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

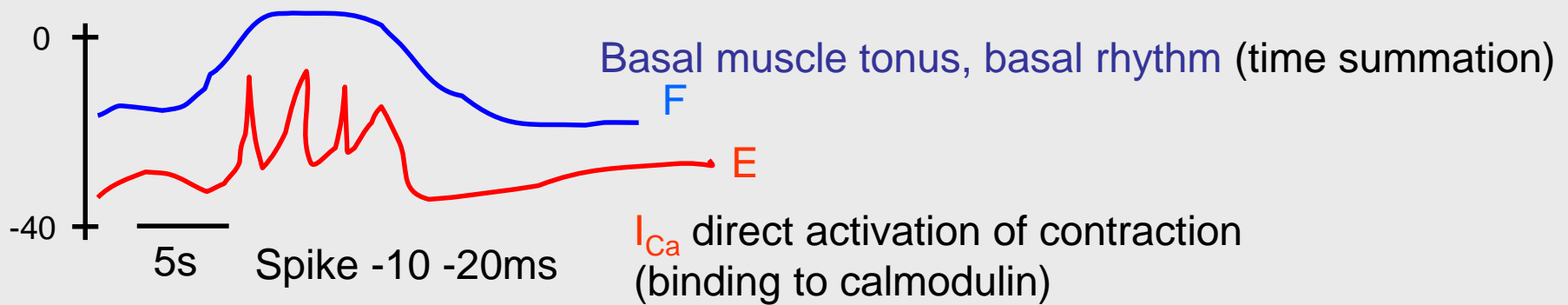
neurohumoural regulation

Variability

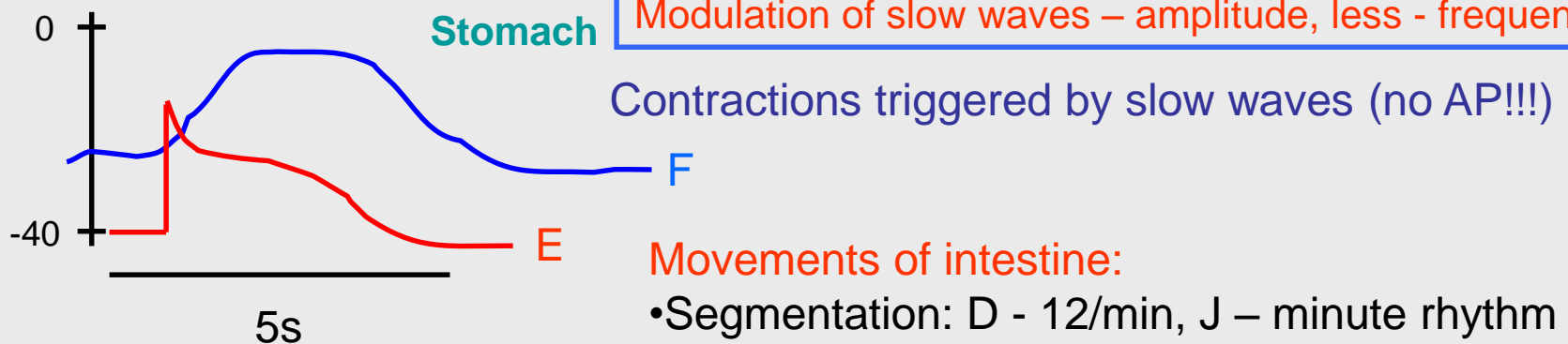
Innervations: nexus, innervations of circular muscle >> longitudinal muscle

No motor endplate

Ach, ENS, exceptions



Modulation of slow waves – amplitude, less - frequency

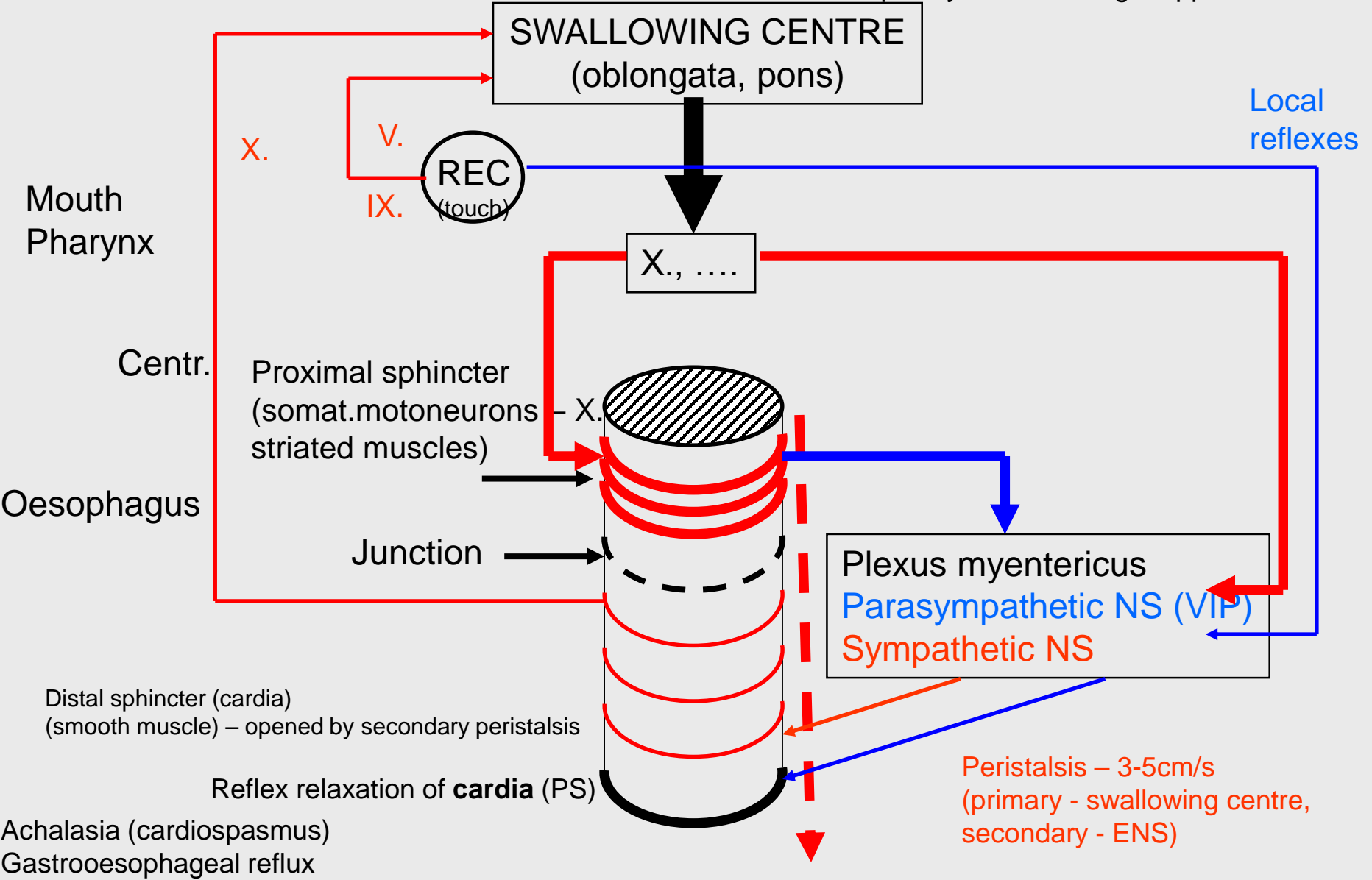


- Segmentation: D - 12/min, J – minute rhythm
- Peristalsis

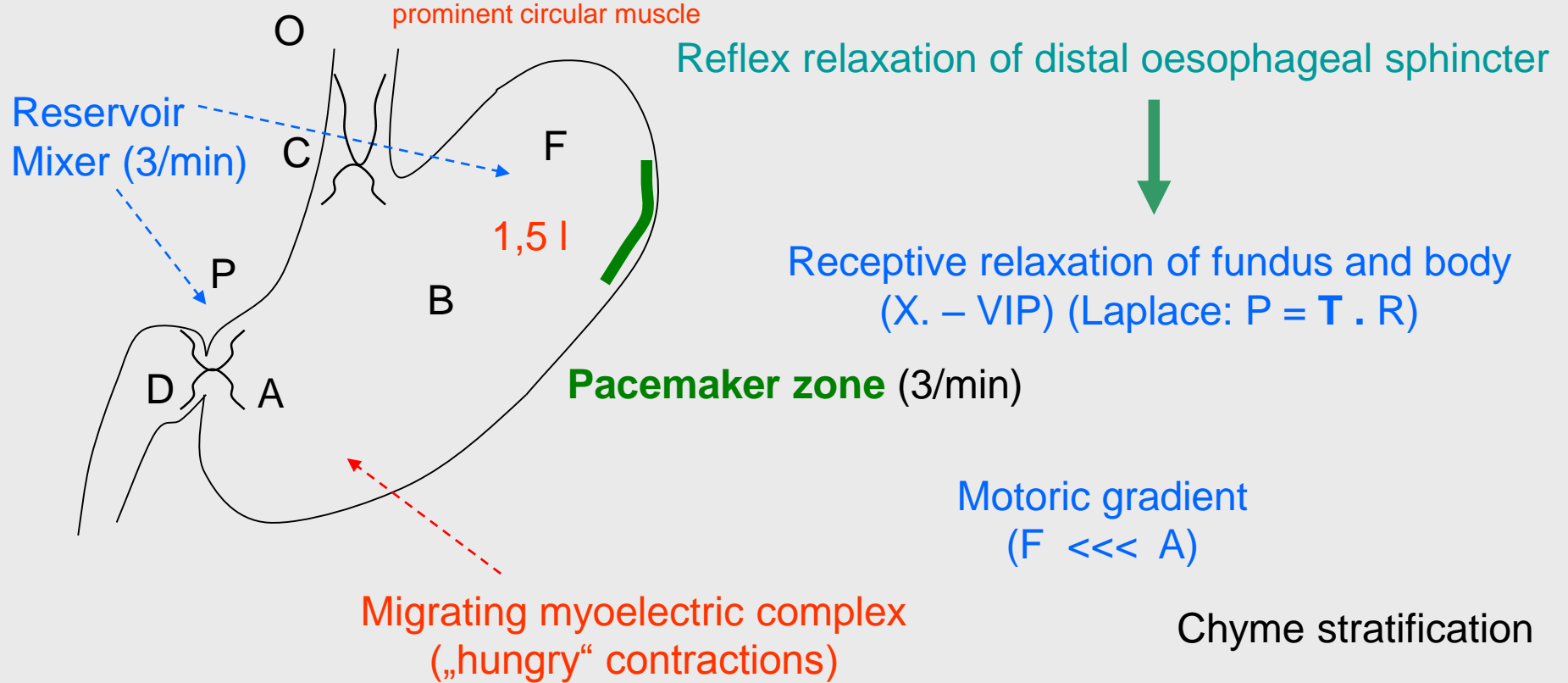
SWALLOWING

- **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

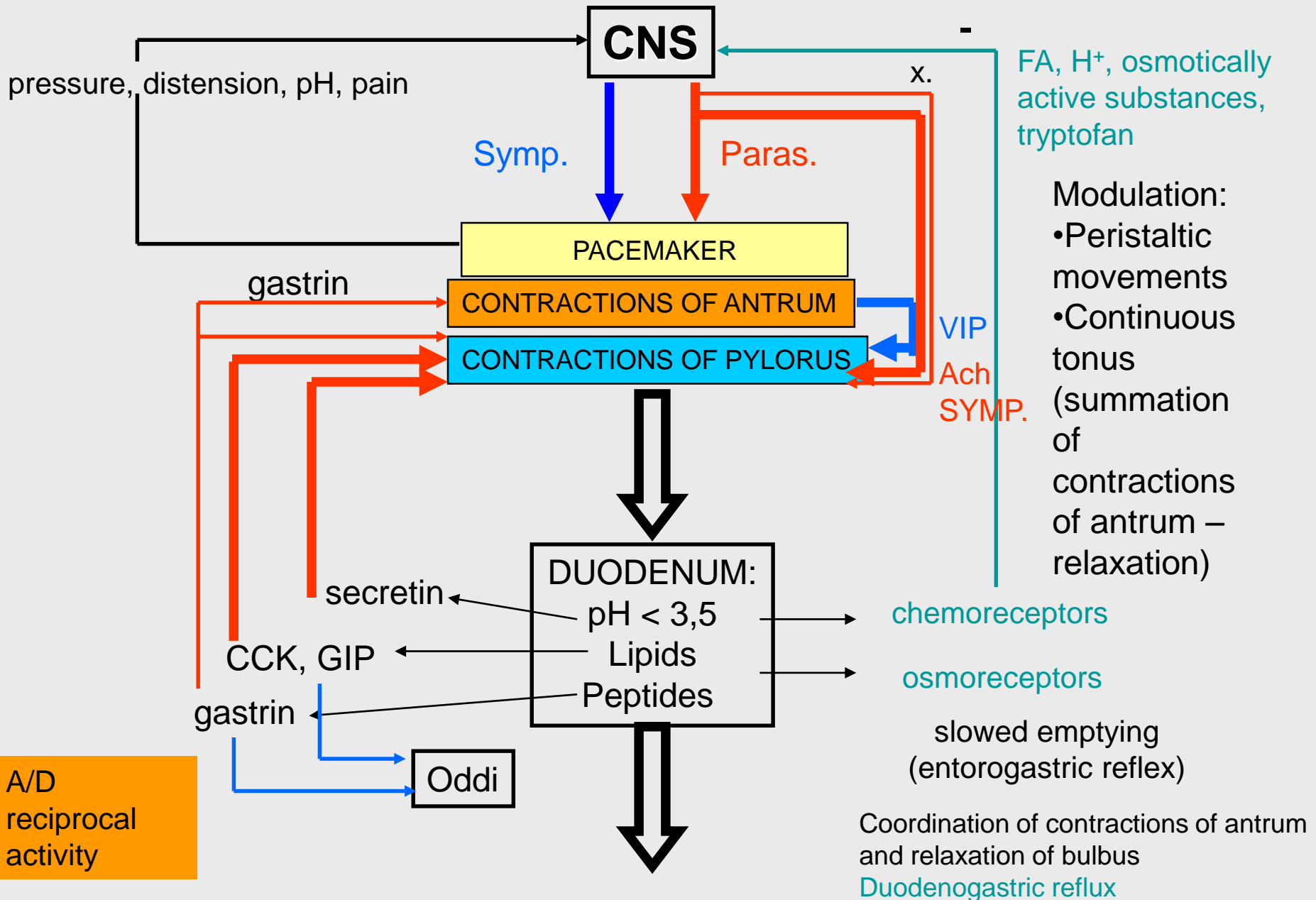
Smooth muscle

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

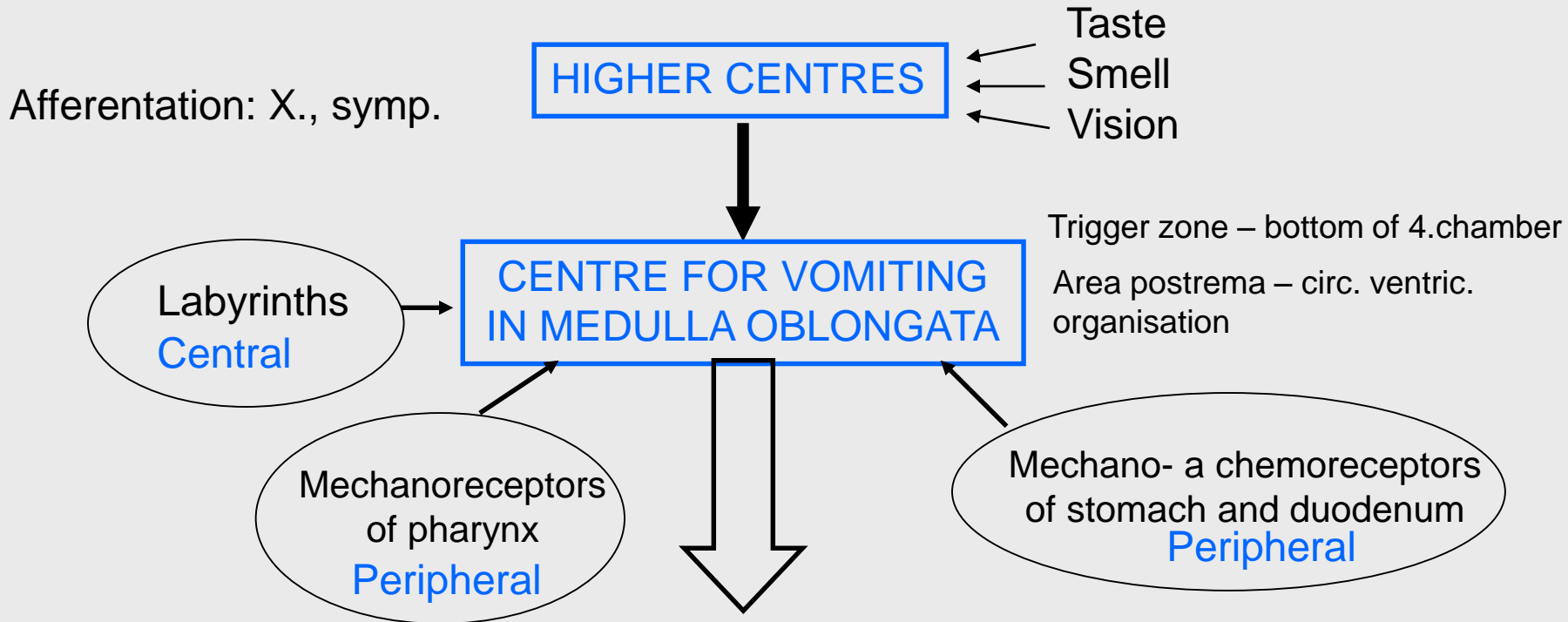
N. vagus +

Plexus caelicus -

EMPTYING OF STOMACH



VOMITING (PROTECTION)



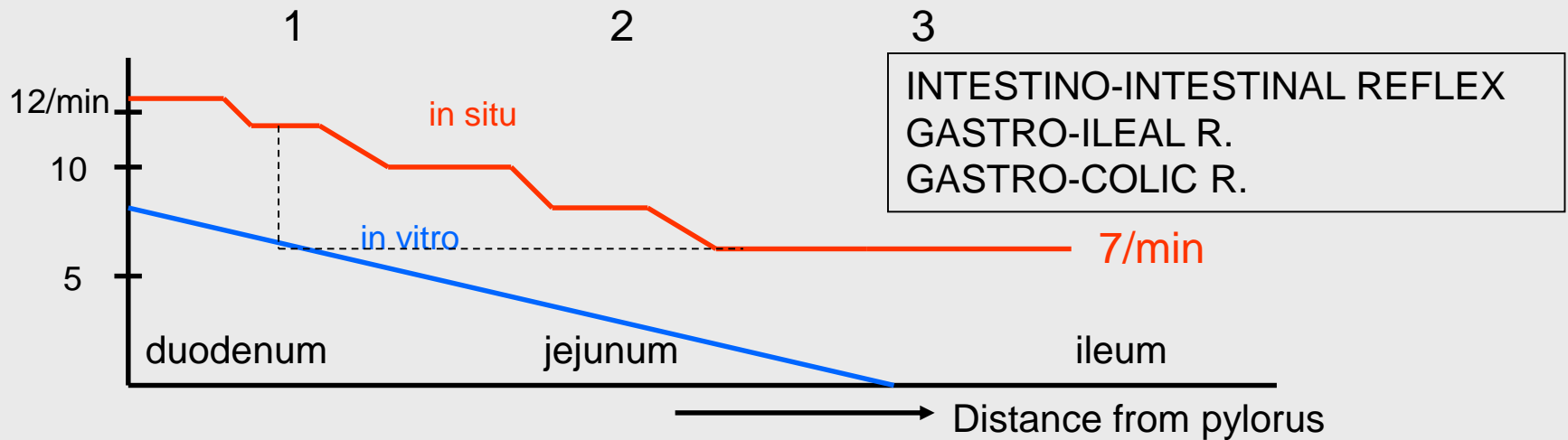
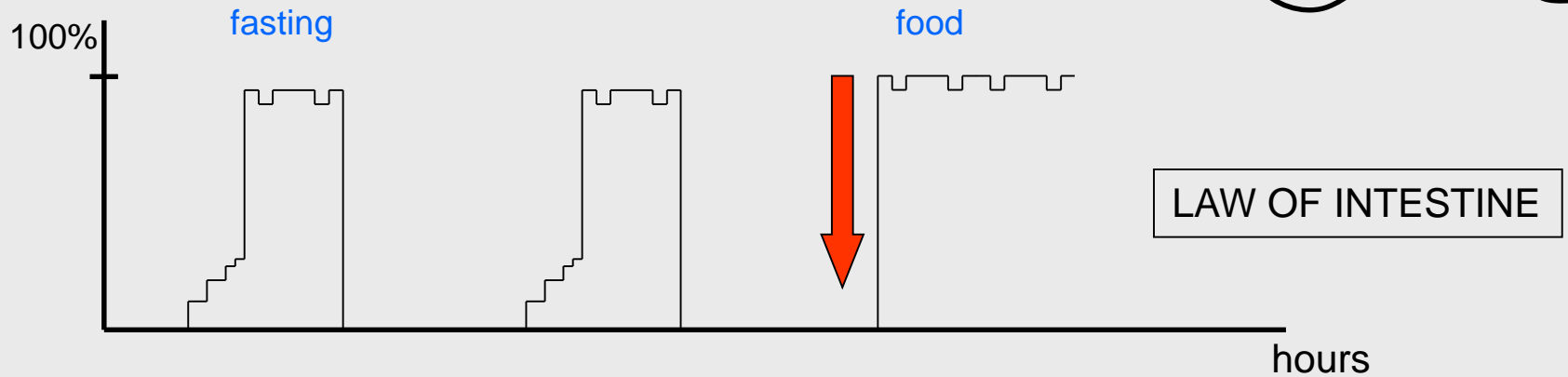
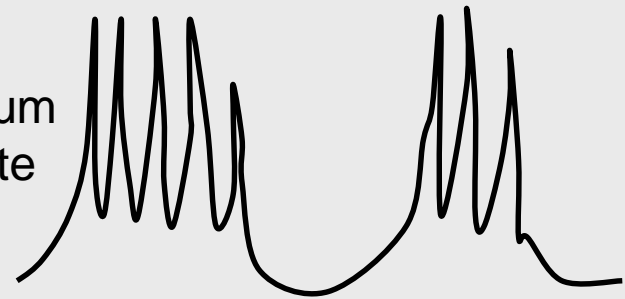
- Antiperistalsis in jejunum and duodenum
- Relaxation of pylorus and antrum
- Contractions of diaphragm (increased intraabdominal pressure)
- Inverse Valsalva manoeuvre (decreased intrathoracal pressure)
- Contractions of pylorus and antrum
- Relaxation of cardia
- Relaxation of upper pharyngeal sphincter

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)

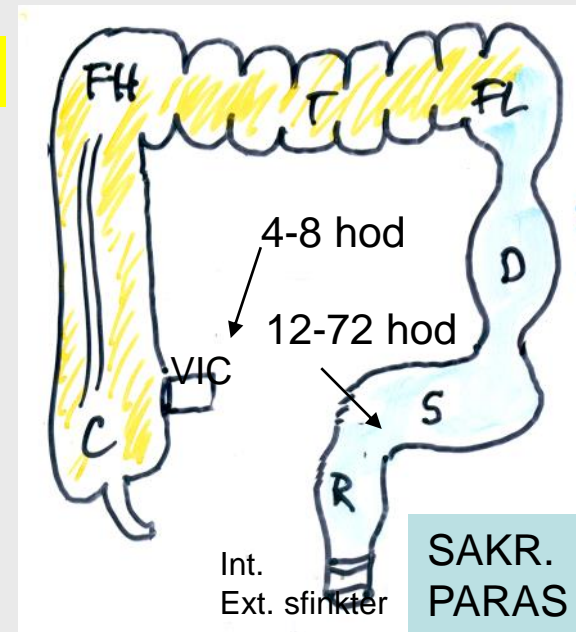


Segmentation >>> peristalsis (up to 10 cm)

MOTILITY OF COLON

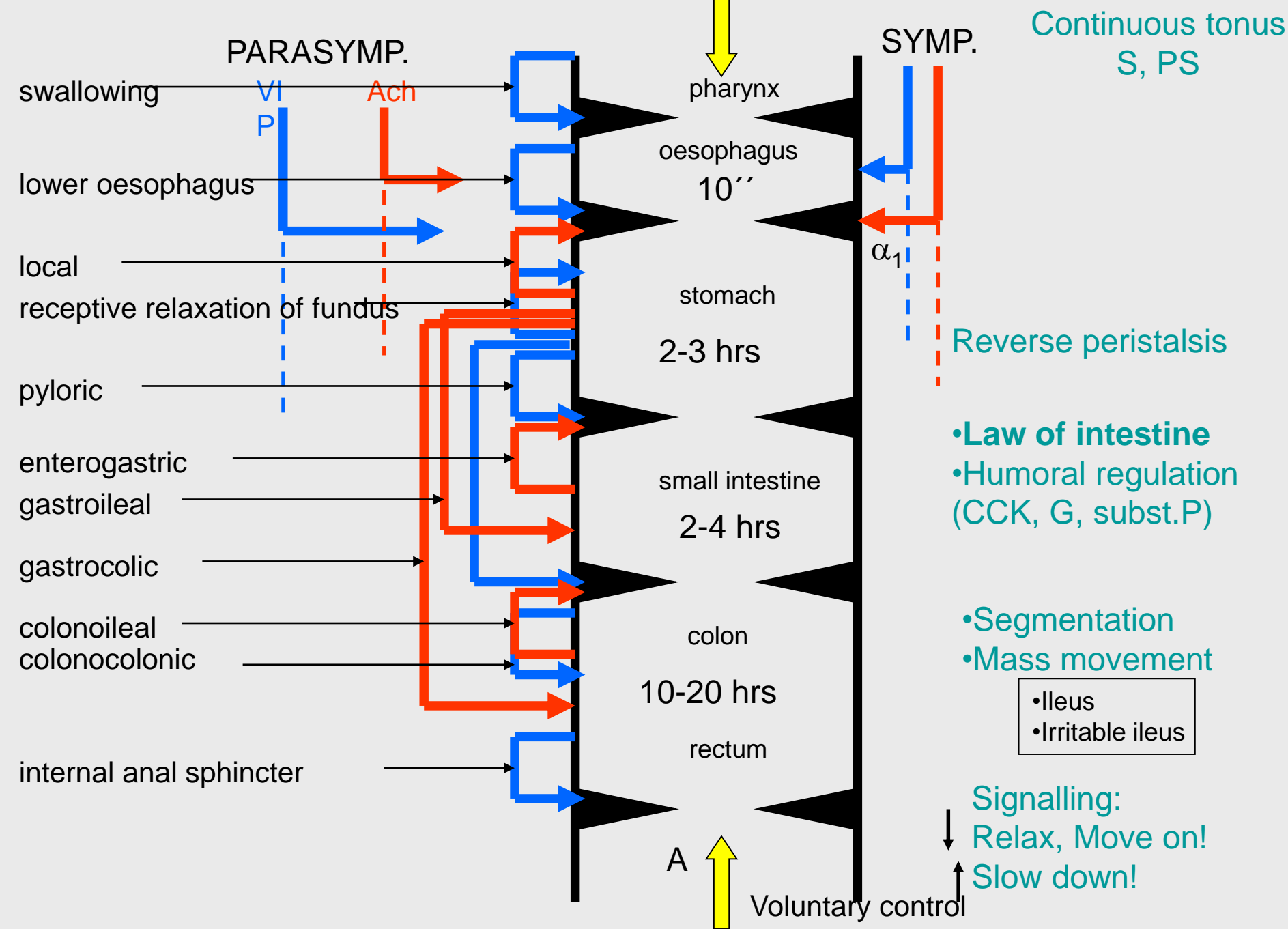
- Slow waves with frequency 4 – 6 / min
- Segmentation = **haustra**; 5-10 cm/hour – **pendulum movements**
- **Mass peristalsis**; 1-3/day – „sweeping“
- Reverse peristalsis – in proximal colon („delay“ – absorption of water and ions)
- Control of anal sphincter: int. – reflex, ext. – voluntary (+reflex)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

PS



- Parasympathetic + (X. till FL)
- Sympathetic – (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

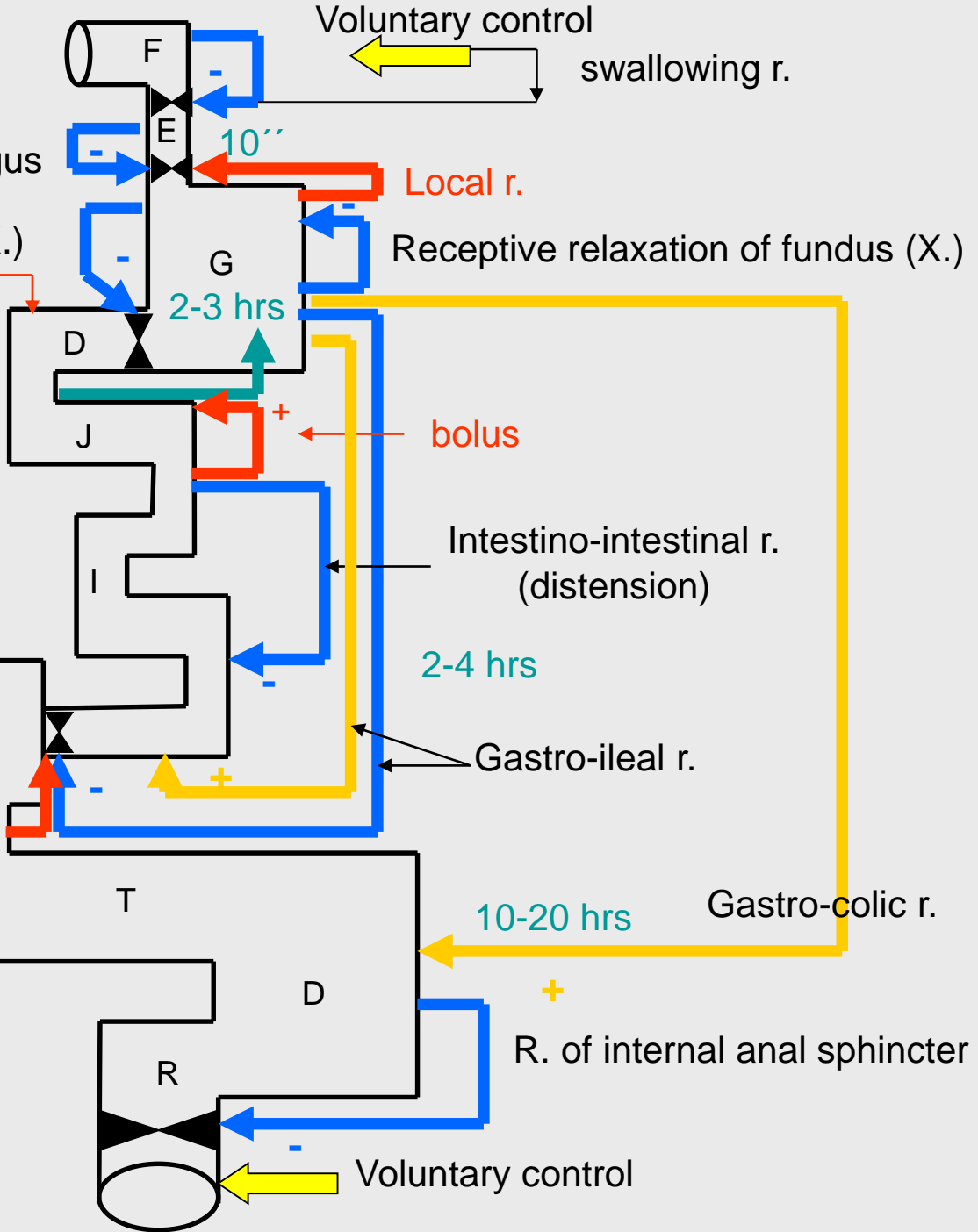
Motility is increased:

- CCK
- Substance P
- Gastrin

Colono-ileal r. (+)

Colono-colonic r.

- Mass peristaltic movements
- Haustra, segmentation
- Reverse peristalsis



Voluntary control
swallowing r.

10''
Local r.

Receptive relaxation of fundus (X.)

2-3 hrs

bolus

Intestino-intestinal r.
(distension)

2-4 hrs

Gastro-ileal r.

10-20 hrs
Gastro-colic r.

R. of internal anal sphincter

Voluntary control