

Key concepts in Digestion...
GORD module

Protection of the digestive system

...practising safe digestion...

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UNIVERSITY OF
LIVERPOOL

Contribution to the following milestone set out for CLC1:

FoP2.1(1) identify and describe the common/ serious, extrinsic and intrinsic factors that can affect the normal biological processes in individual organs or organ systems, which could affect the level of oral and general health risk, treatment complications and/or outcomes

How can we practice safe digestion?

Objectives: - To develop an understanding of:

- 1. the defensive role of the mucosal barrier and the consequences for the gut when protection fails**
- 2. how the gastrointestinal epithelium responds when insult leads to injury**
- 3. how the gut detects and removes infectious agents**
- 4. the mechanisms to sense and remove any damaged/mutated cells**
- 5. the mechanisms and regulation of vomiting**

Attack and defence in the gut

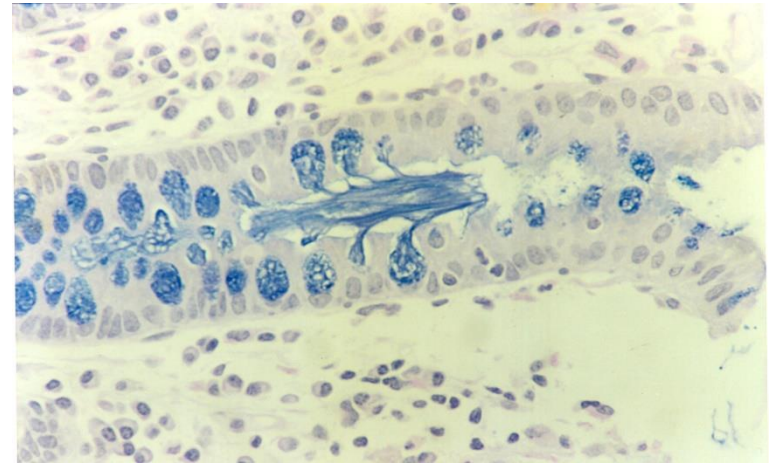
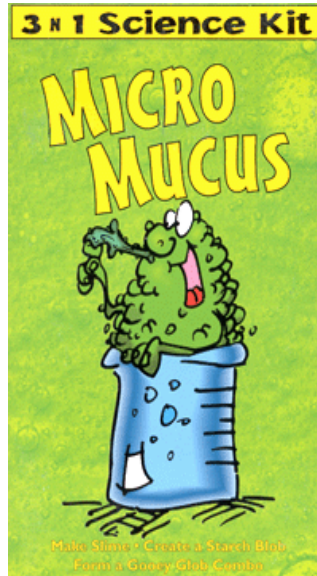
Damaging

Acid and pepsin
Ingested drugs (alcohol, aspirin)
Refluxed bile
Smoking
Micro-organisms (e.g. *H.pylori*)
Ischemia (oxidative stress)
Food allergens

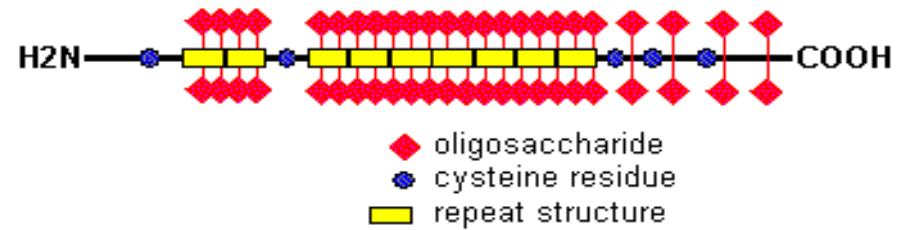
Protective

Mucus-HCO₃
Cell membrane
Cell migration and renewal
Mucosal blood flow
Prostaglandins
Immune system
Acid inhibition
Programmed cell death

Mucus



Generic structure of a mucin monomer



Attack and defence in the stomach

Acid & pepsin

pH 2

Cell surface
phospholipids

Mucus- HCO_3^-
barrier slows H^+
diffusion

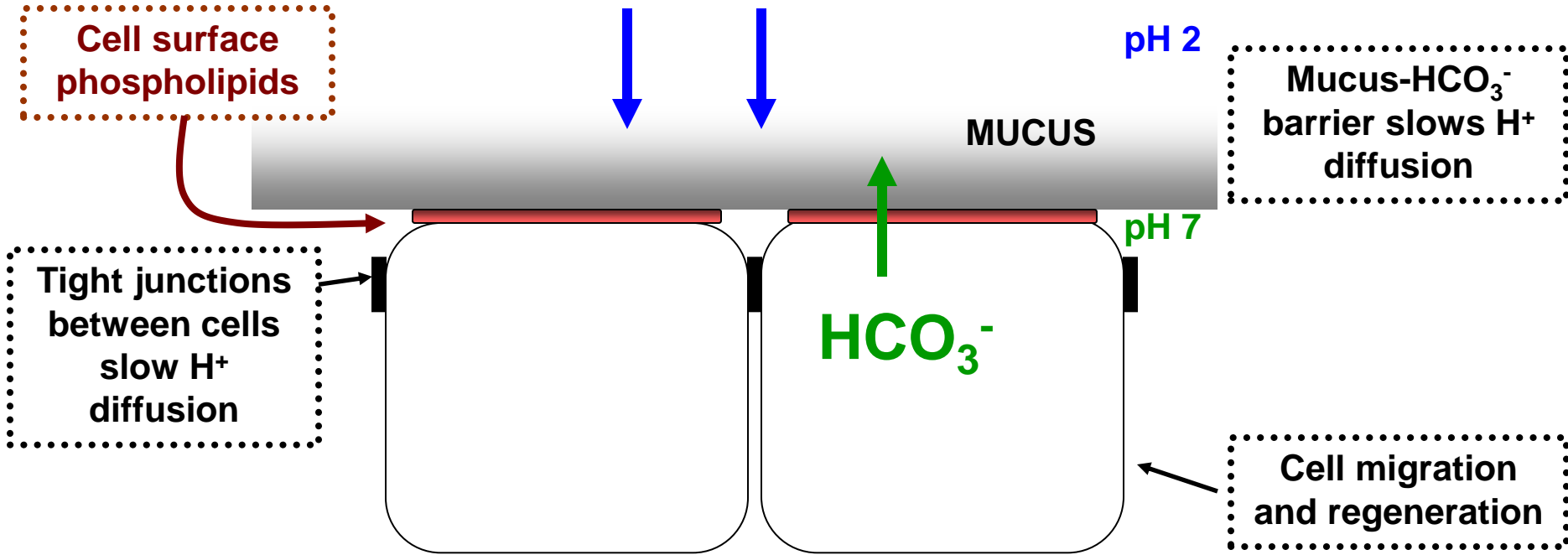
MUCUS

pH 7

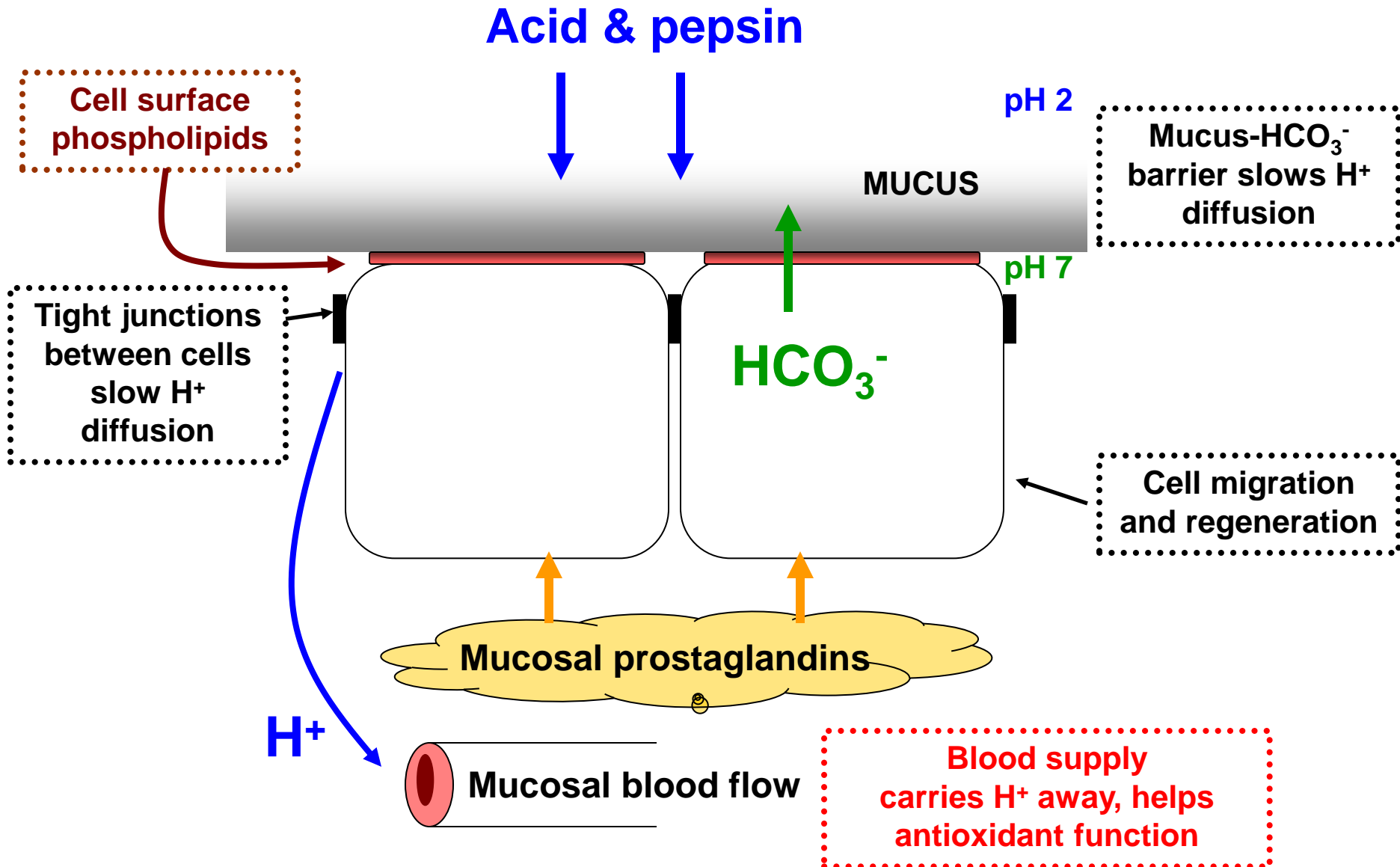
Tight junctions
between cells
slow H^+
diffusion

HCO_3^-

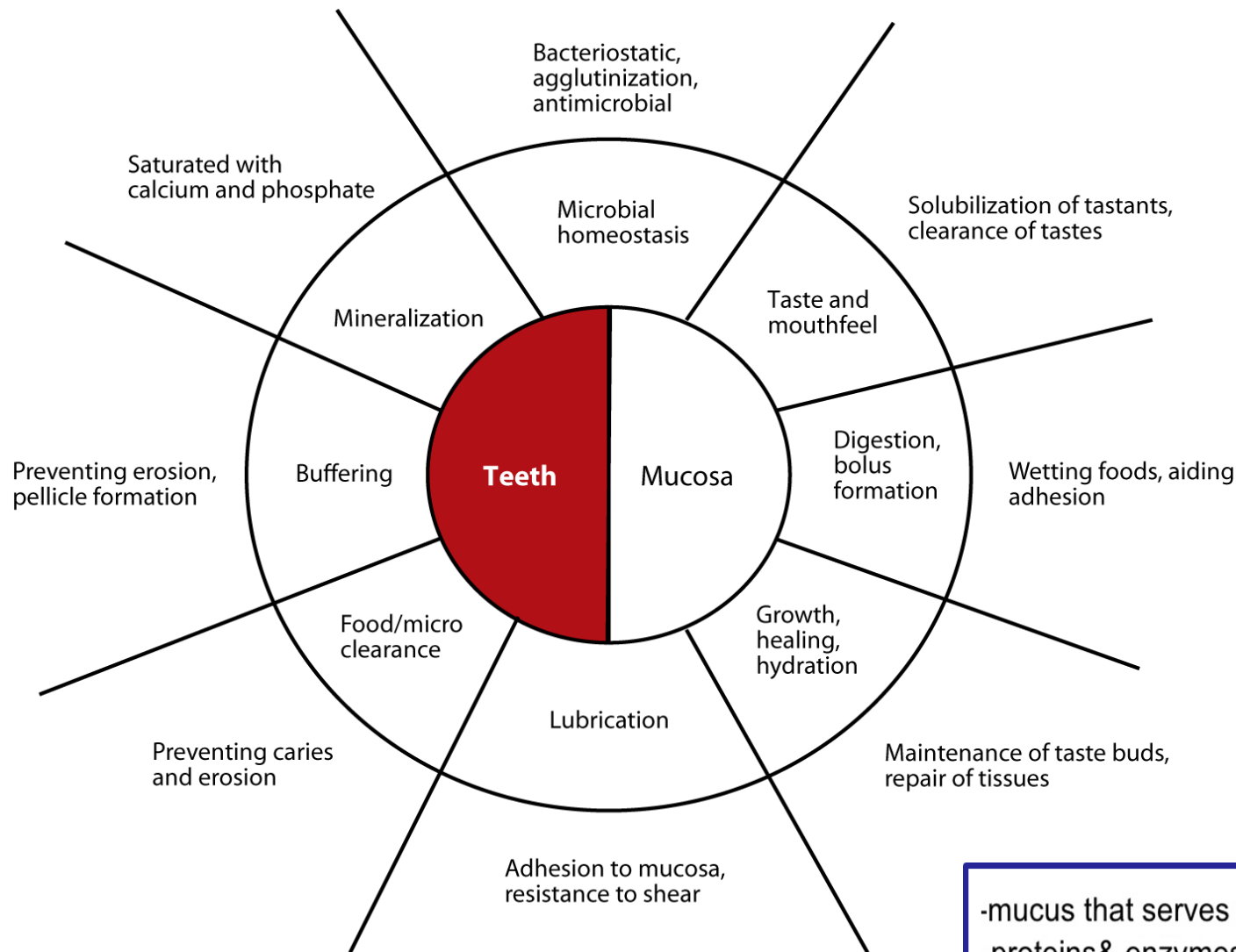
Cell migration
and regeneration



Attack and defence in the stomach



Salivary functions include defence



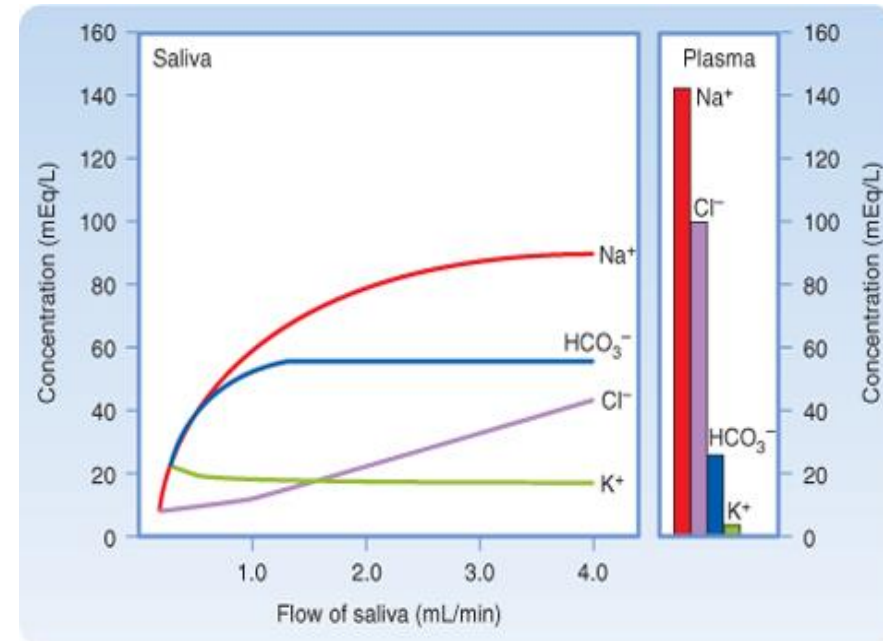
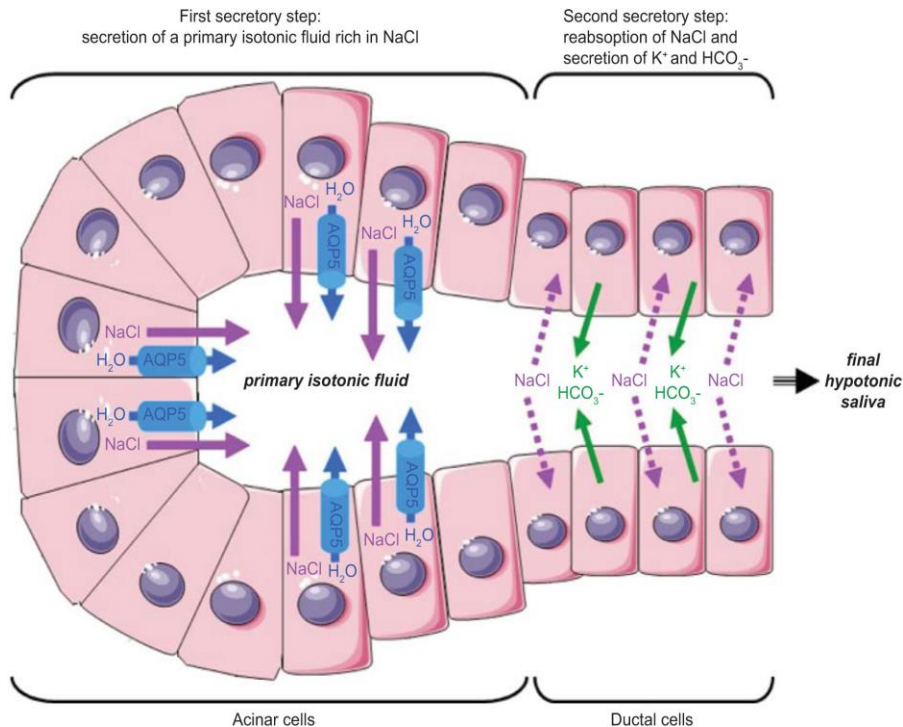
-mucus that serves as a lubricant.
-proteins& enzymes: Statherins, Proline-rich Proteins (PRPs), Histatins, Cystatins, Lysozyme, Salivary peroxidase



Carpenter GH. 2013.

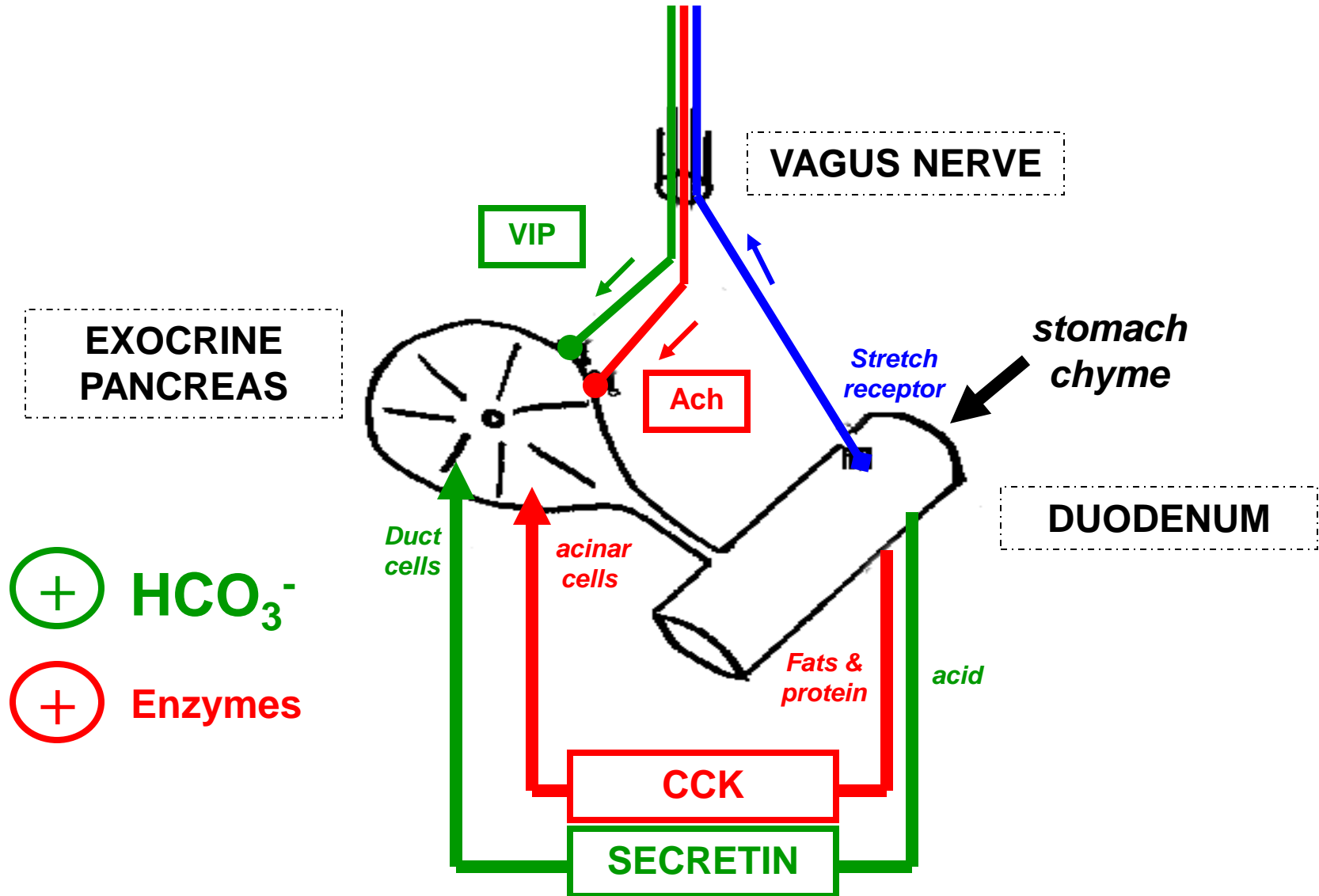
Annu. Rev. Food Sci. Technol. 4:267–76

Salivary secretion at high flow rates is rich in acid neutralising bicarbonate ions

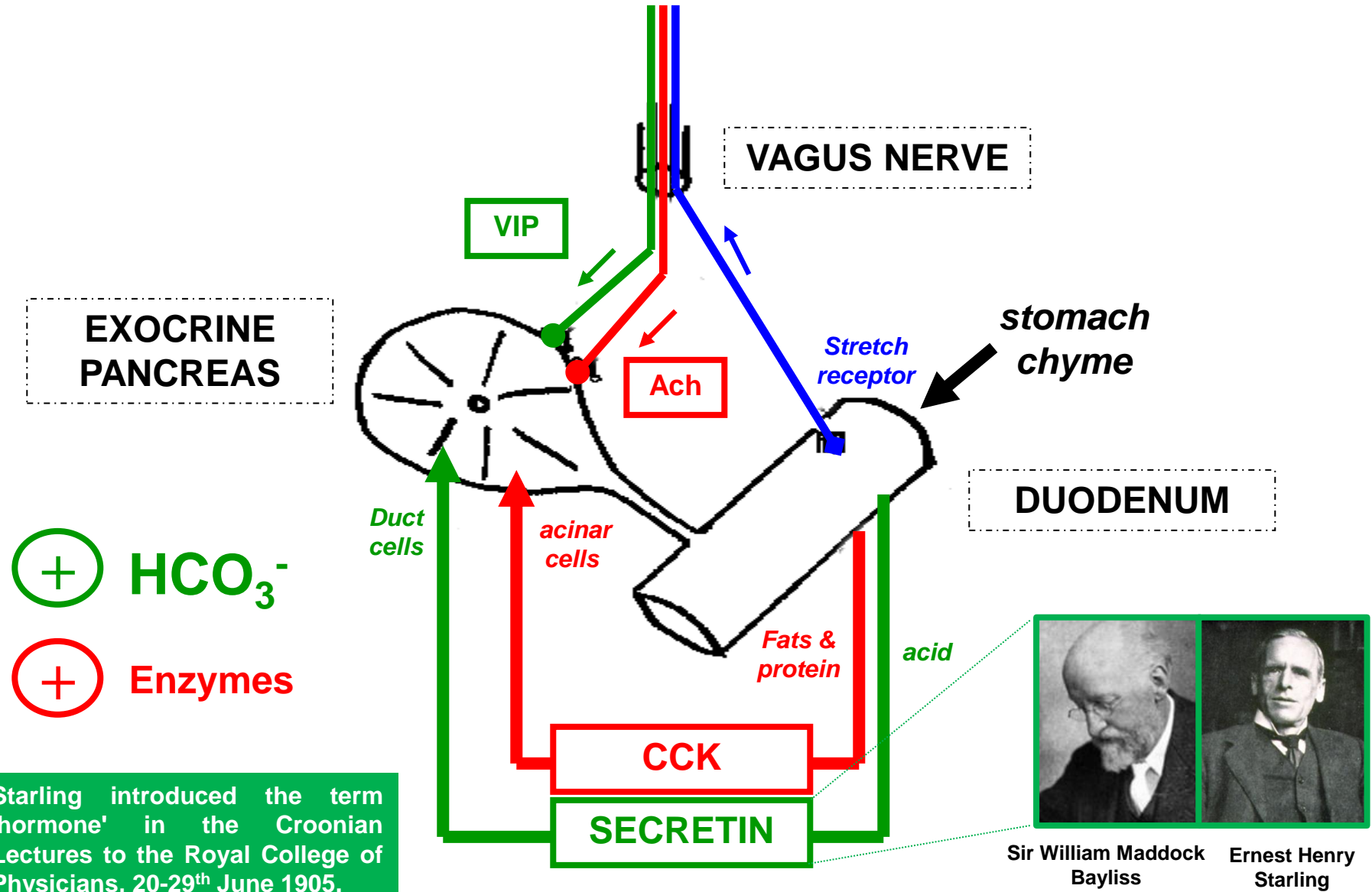


- Primary saliva is isotonic, it is both reabsorbed and secreted.
- If flow is slow, more of HCO₃⁻ is reabsorbed by the striated duct cells generating a hypotonic saliva
- If the flow is high less HCO₃⁻ is reabsorbed.
- **Therefore when flow rate increases HCO₃⁻ concentration increases.**

The exocrine pancreas produces bicarbonate to neutralise acidic stomach chyme

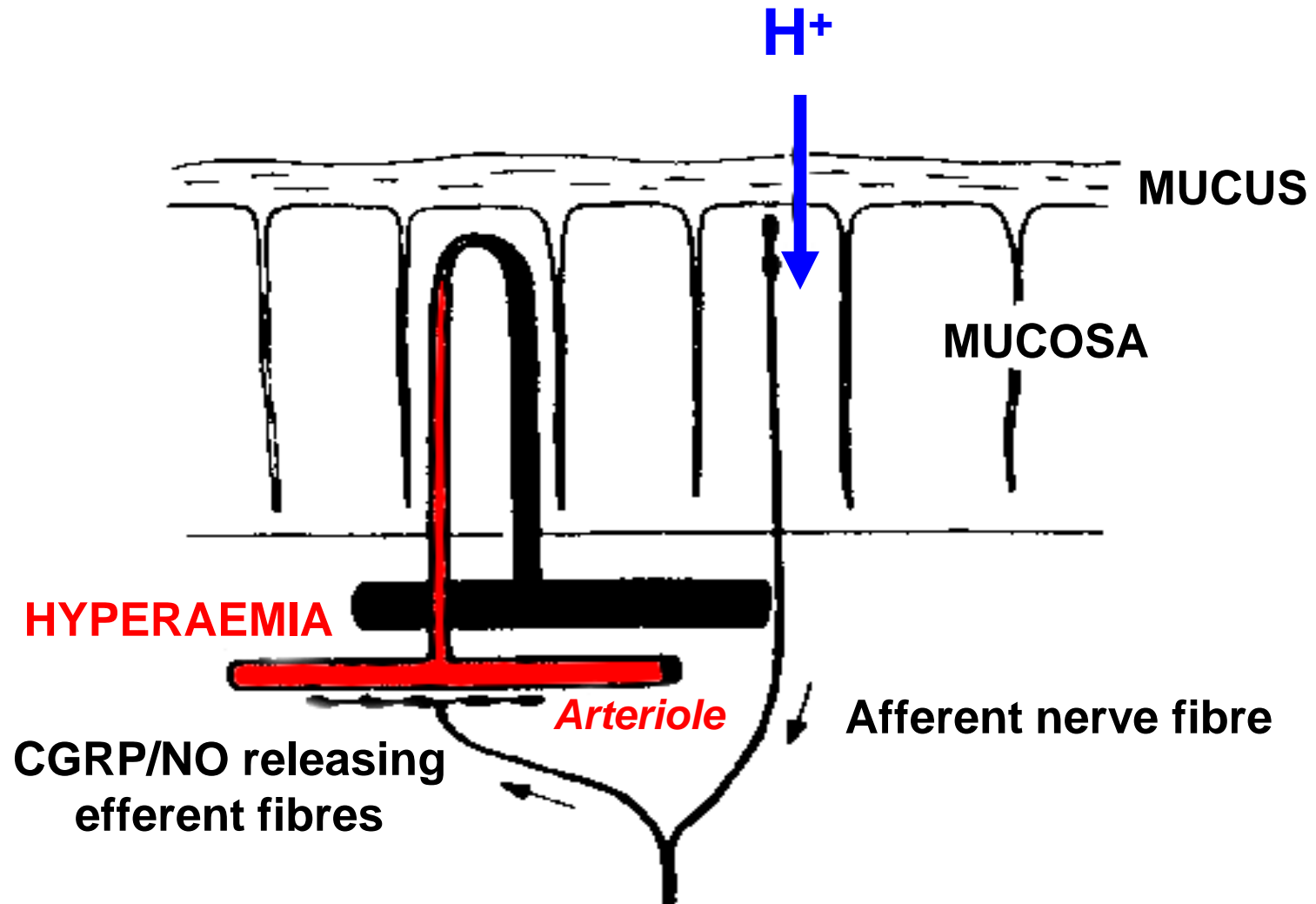


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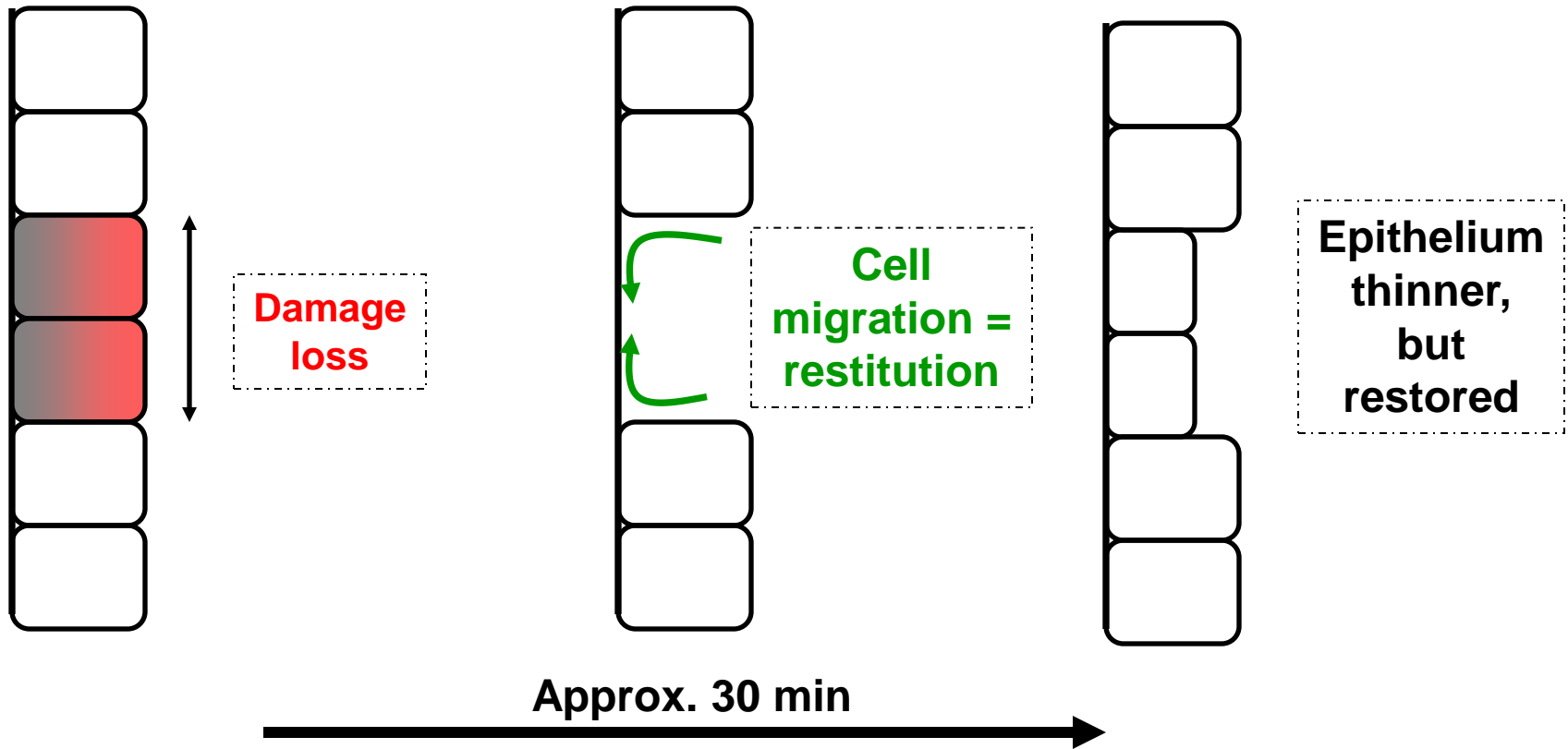


Starling introduced the term 'hormone' in the Croonian Lectures to the Royal College of Physicians, 20-29th June 1905.

Increased blood flow in response to penetrating acid



Restitution - rapid repair mechanisms



Key players in repair:

Prostaglandins

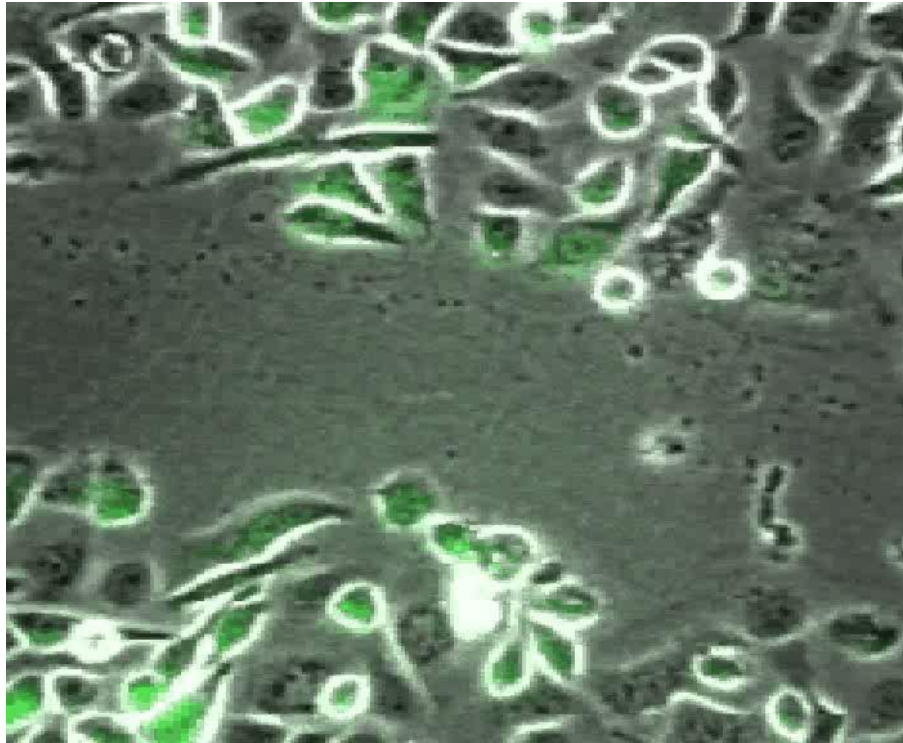
Gastrin

Growth factors

Regenerating protein (Reg)

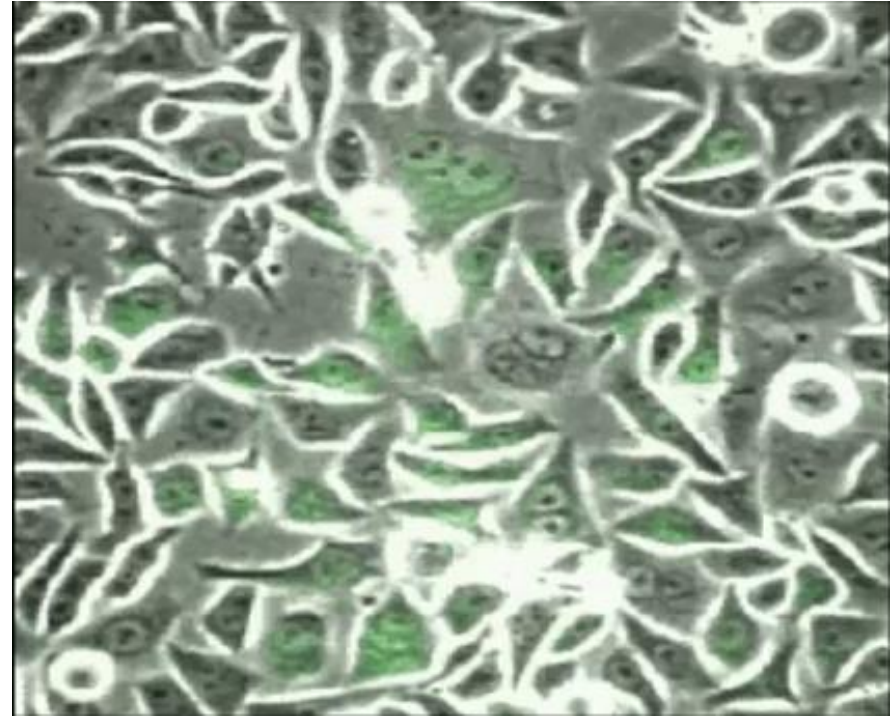
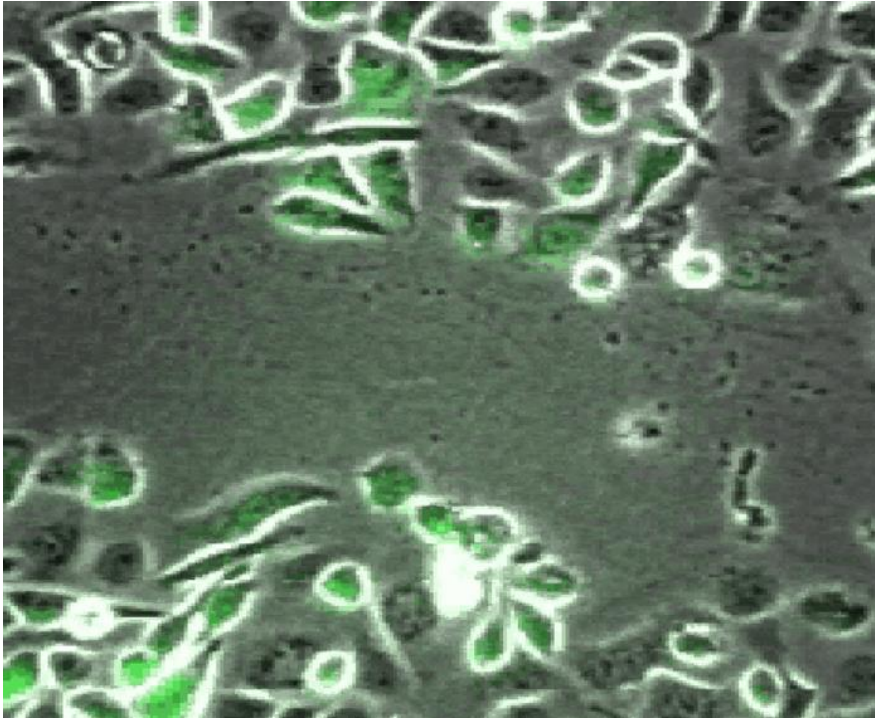
Trefoil peptides

Gastrin stimulates migration



Noble PJ *et al.*, Am J Physiol Gastrointest Liver Physiol. 2003; 284(1):G75-84.

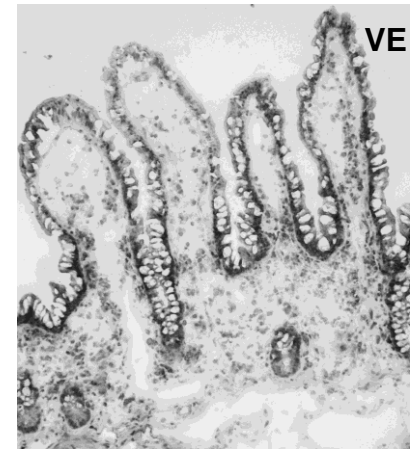
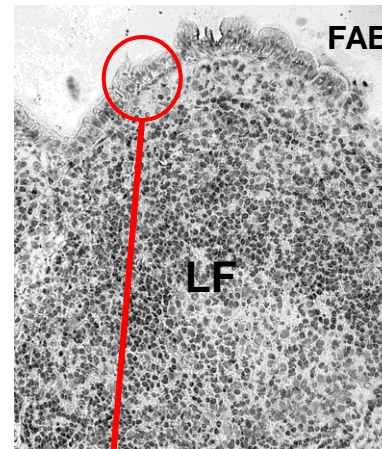
Gastrin stimulates migration



1h post addition of gastrin

Noble PJ *et al.*, Am J Physiol (Gastrointest Liver Physiol.) 2003; 284(1):G75-84.

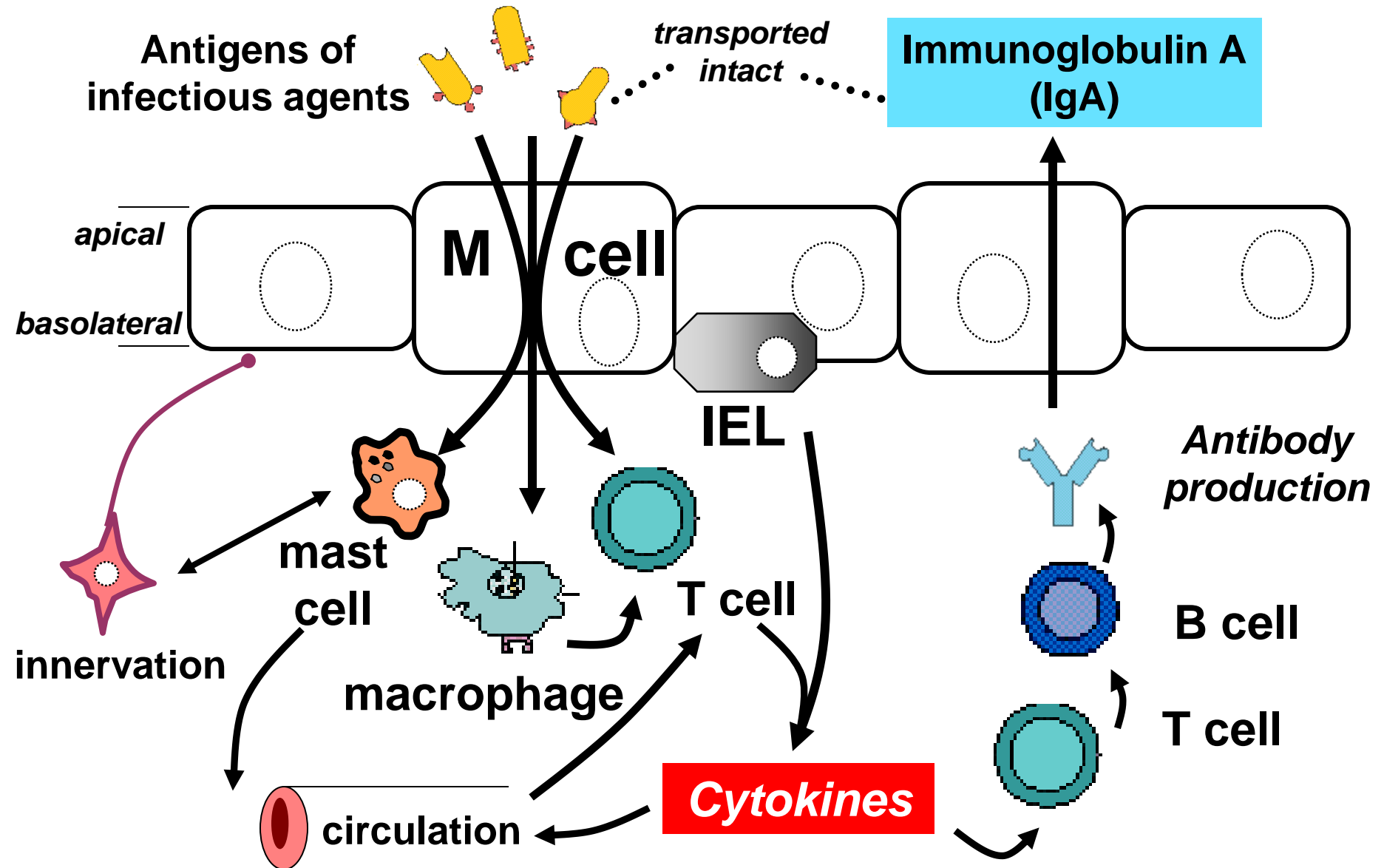
The gut immune system: Peyer's patches



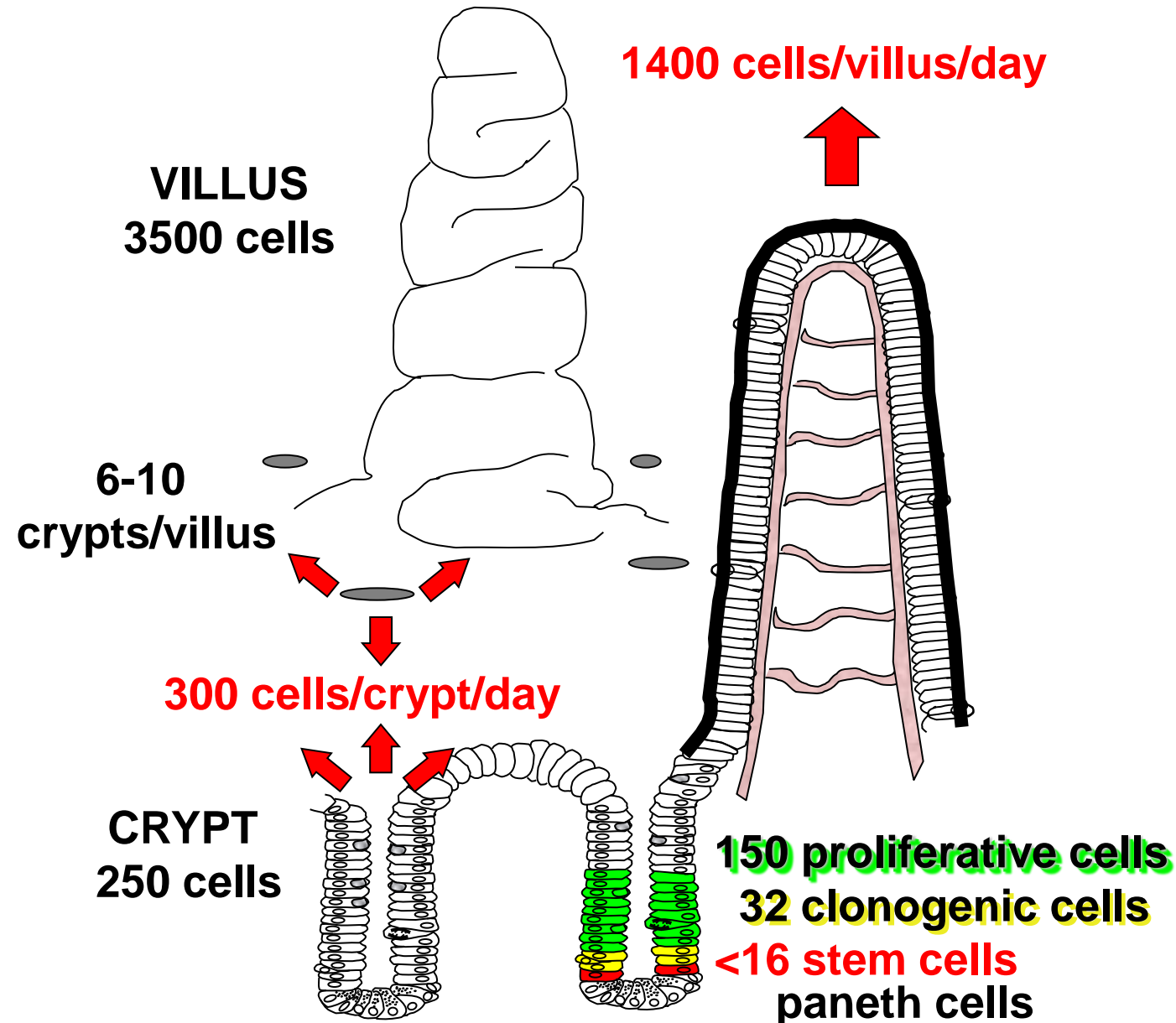
Microfold (M cells)



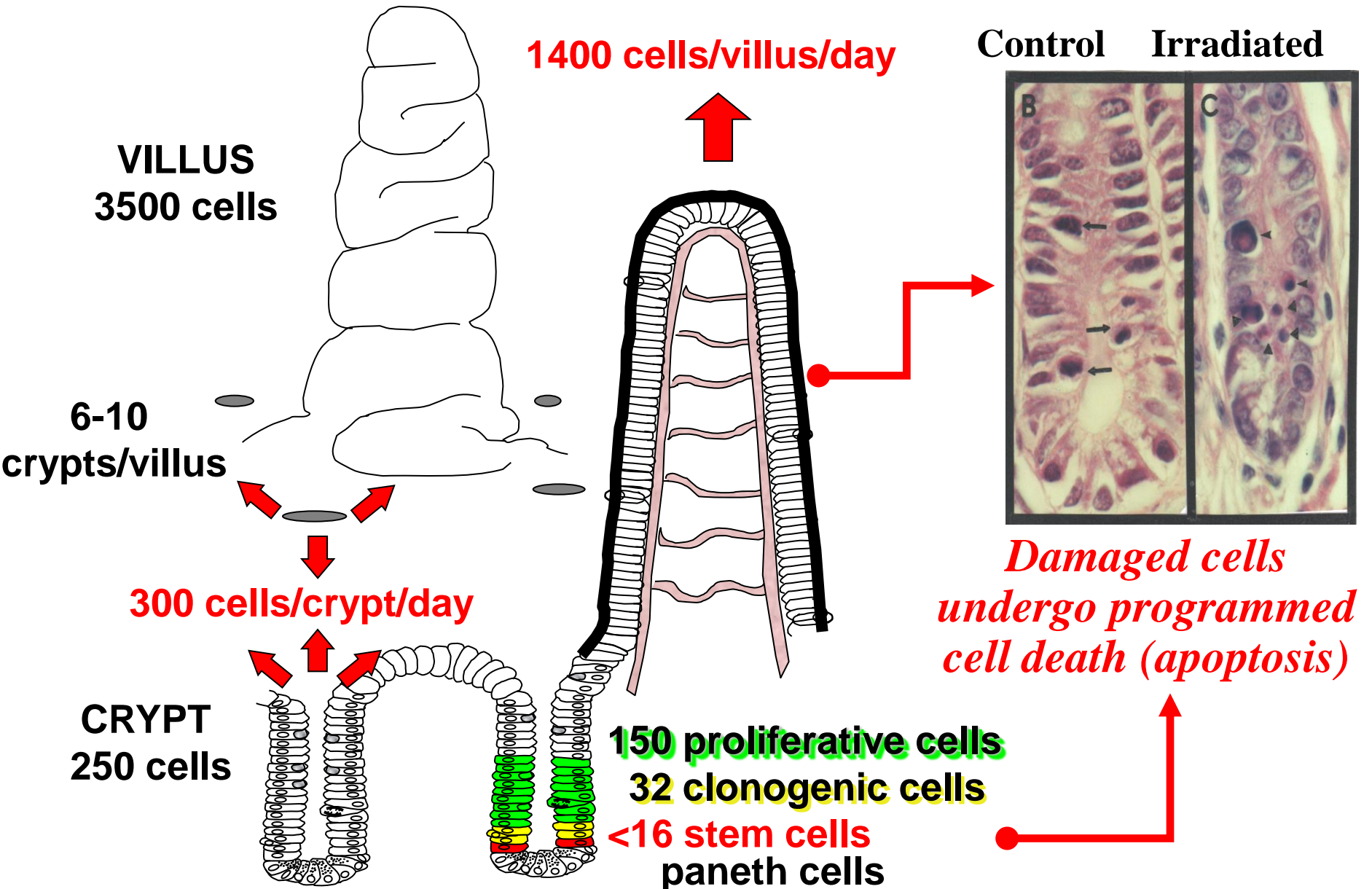
The gut immune system: Peyer's patches



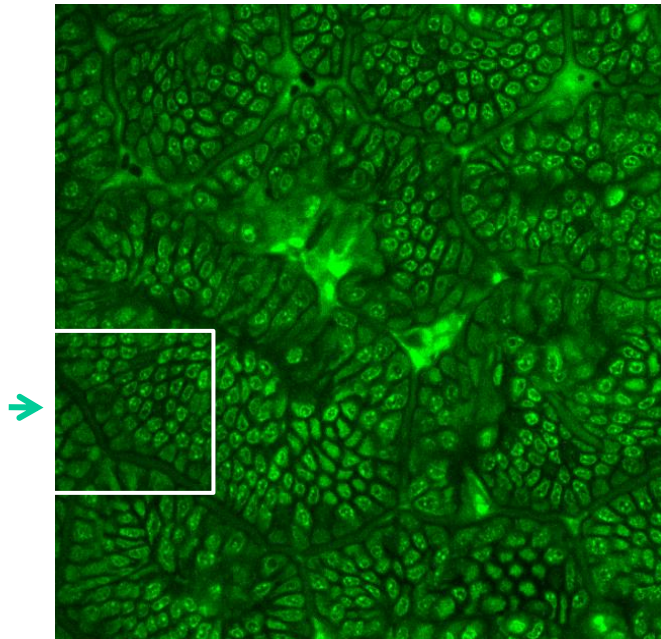
Life and death of an enterocyte



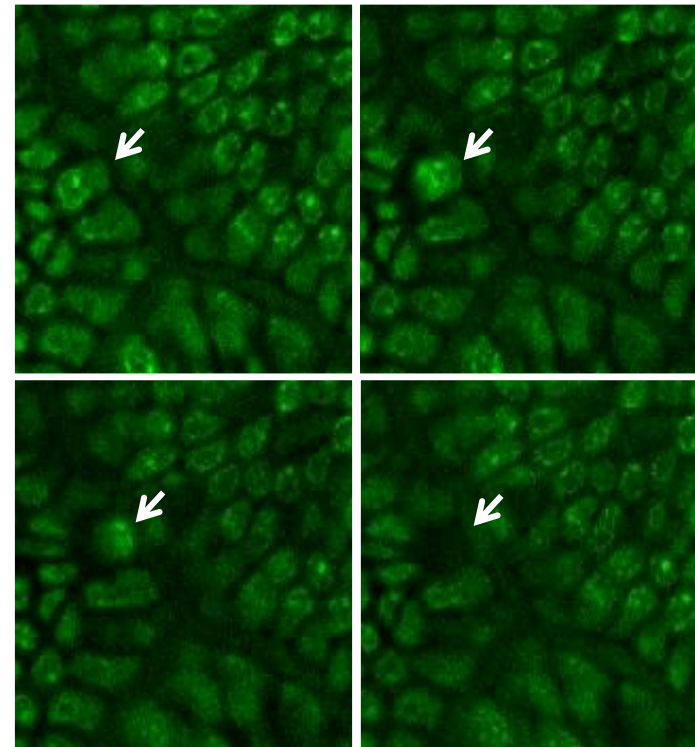
Life and death of an enterocyte



Maintenance of tight junctions during cell shedding



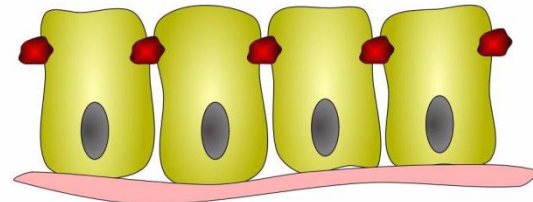
x40 objective.



- **Cells take ~10 min to shed**

Duckworth & Watson 2011
Methods Mol. Biol. 763: 105-114

Williams JM *et al.* 2014 *Vet Pathol* 52: 445-55



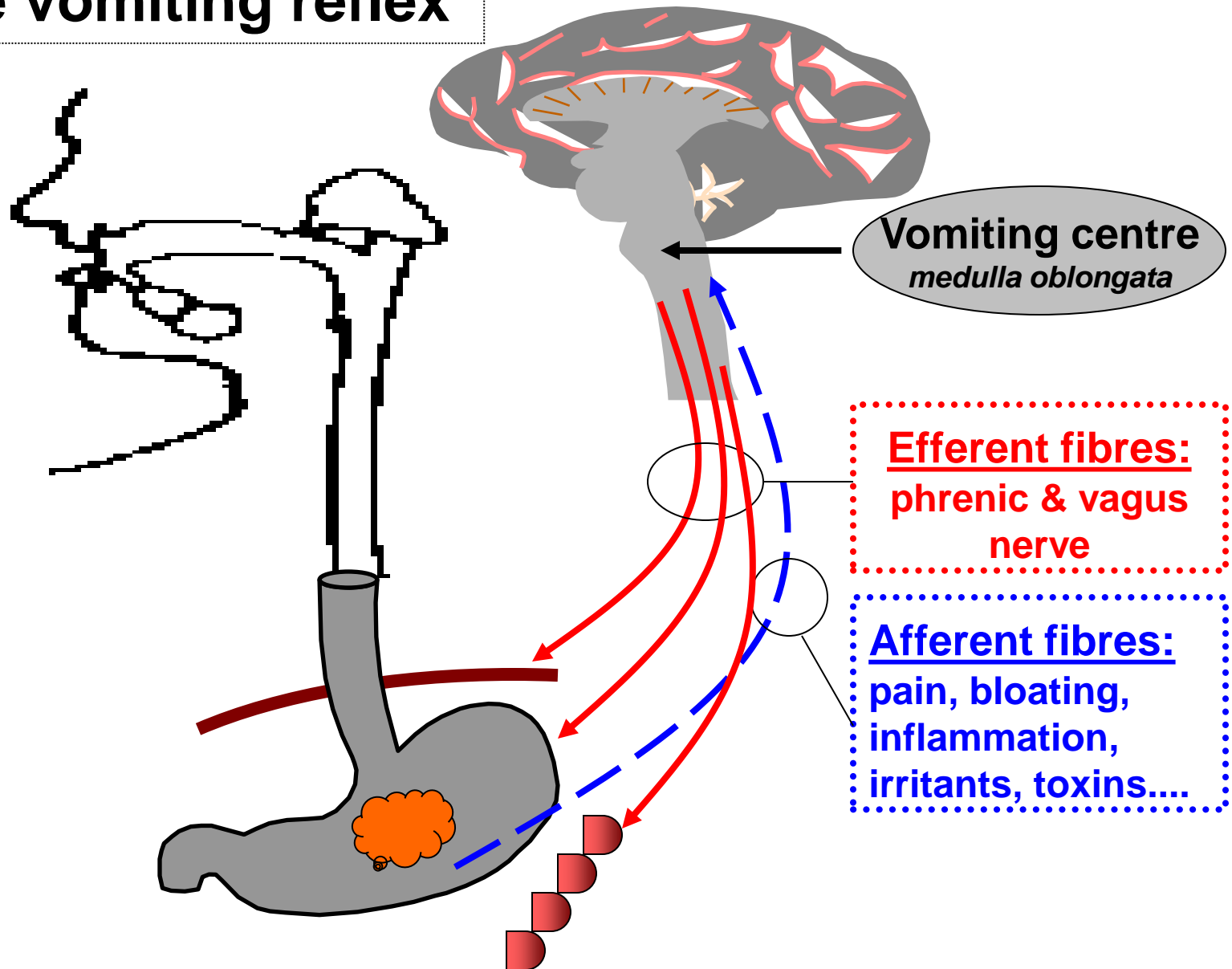
Carrie Duckworth © 2011

Vomiting

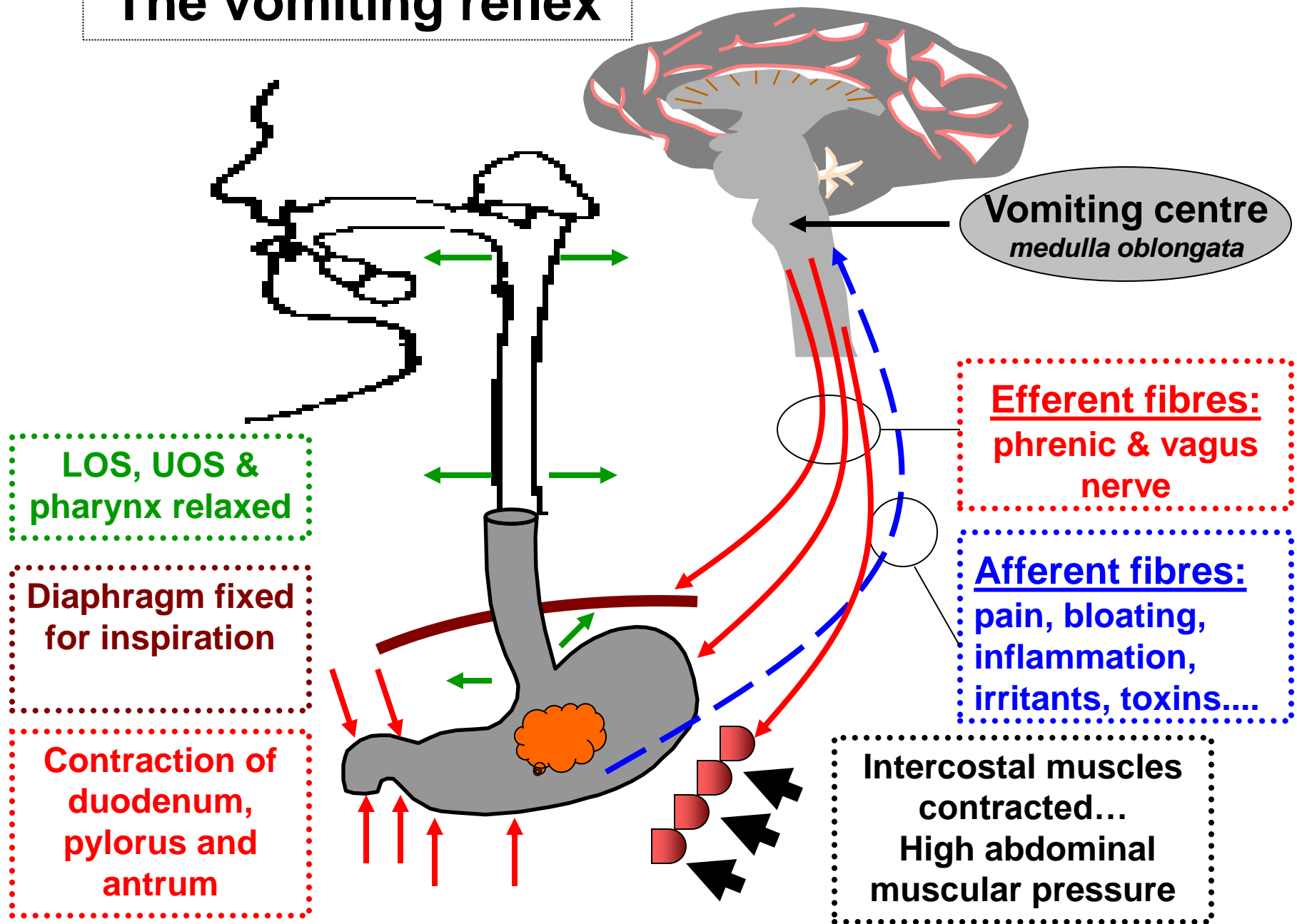
IT'S TIME
TO GO TO
SCHOOL



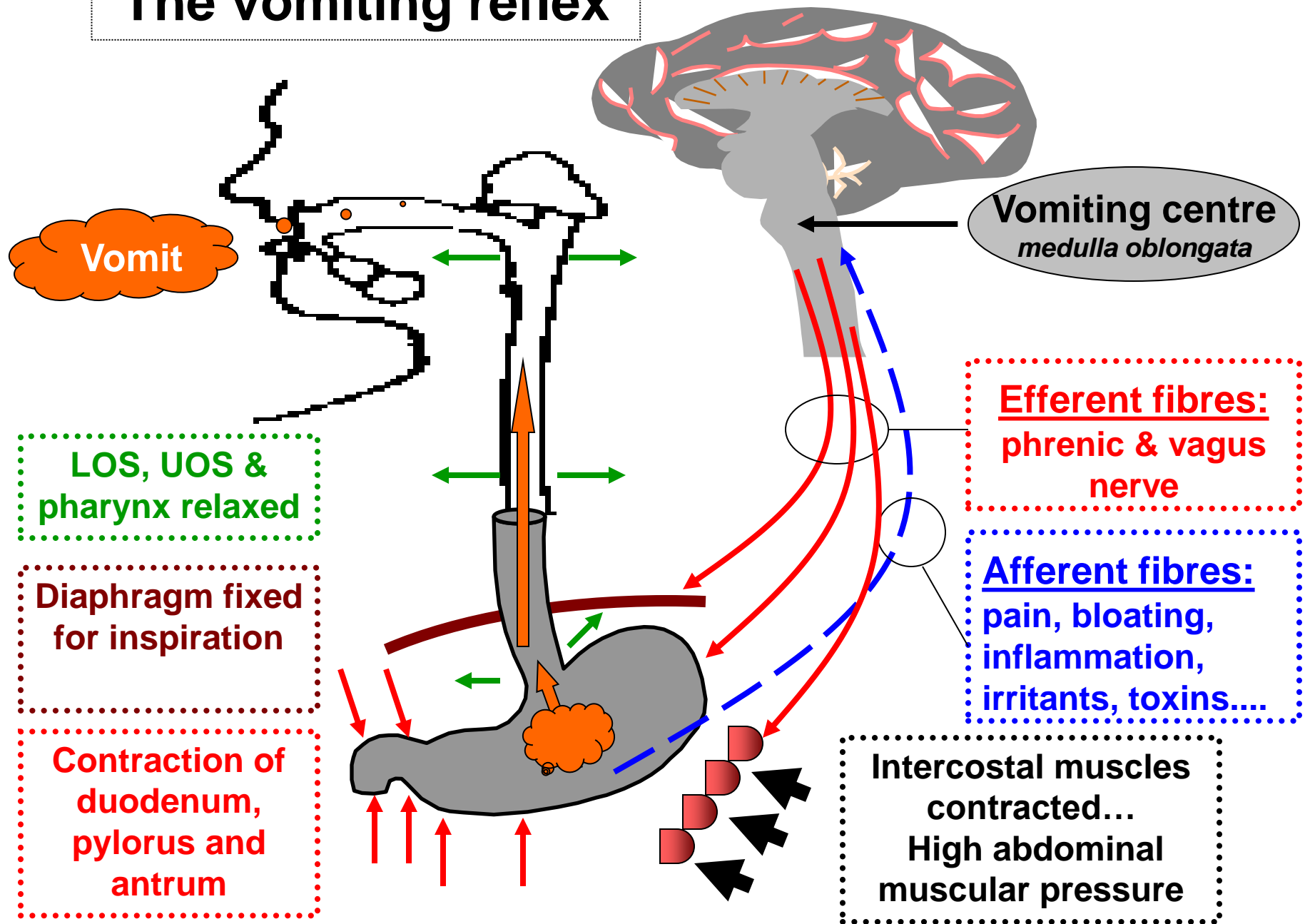
The vomiting reflex



The vomiting reflex



The vomiting reflex



Vomiting



don't stop your curiosity

Every 'experience' is a learning experience!