How the gut protects itself….
‘practising safe digestion’.

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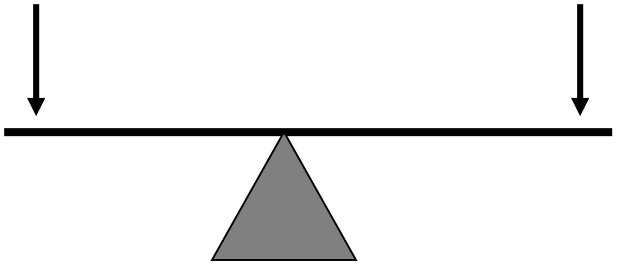
Learning Outcomes:

- **LO1 - Describe the defensive role of the mucosal barrier in response to attack/digestion and the consequences for the gut when protection fails**
- **LO2 - Describe the mucus-bicarbonate barrier**
- **LO3 - Explain the role of prostaglandins in the GI tract**
- **LO4 - Define how the gastrointestinal epithelium responds when insult leads to injury**
- **LO5 - Explain the processes restitution and cell migration in response to gut injury**
- **LO6 - Describe how immune competent tissue monitors intestinal bacteria populations and prevents growth of pathogenic bacteria in the intestine**
- **LO7 - Define the mechanisms to sense and remove damaged cells (e.g. apoptosis [programmed cell death and epithelial shedding)**
- **LO8 - Define the vomiting reflex**

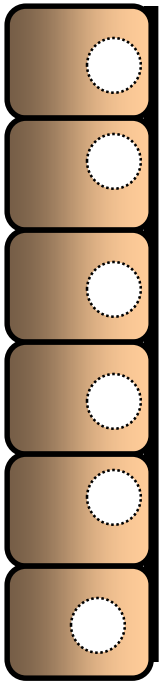
LO1

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

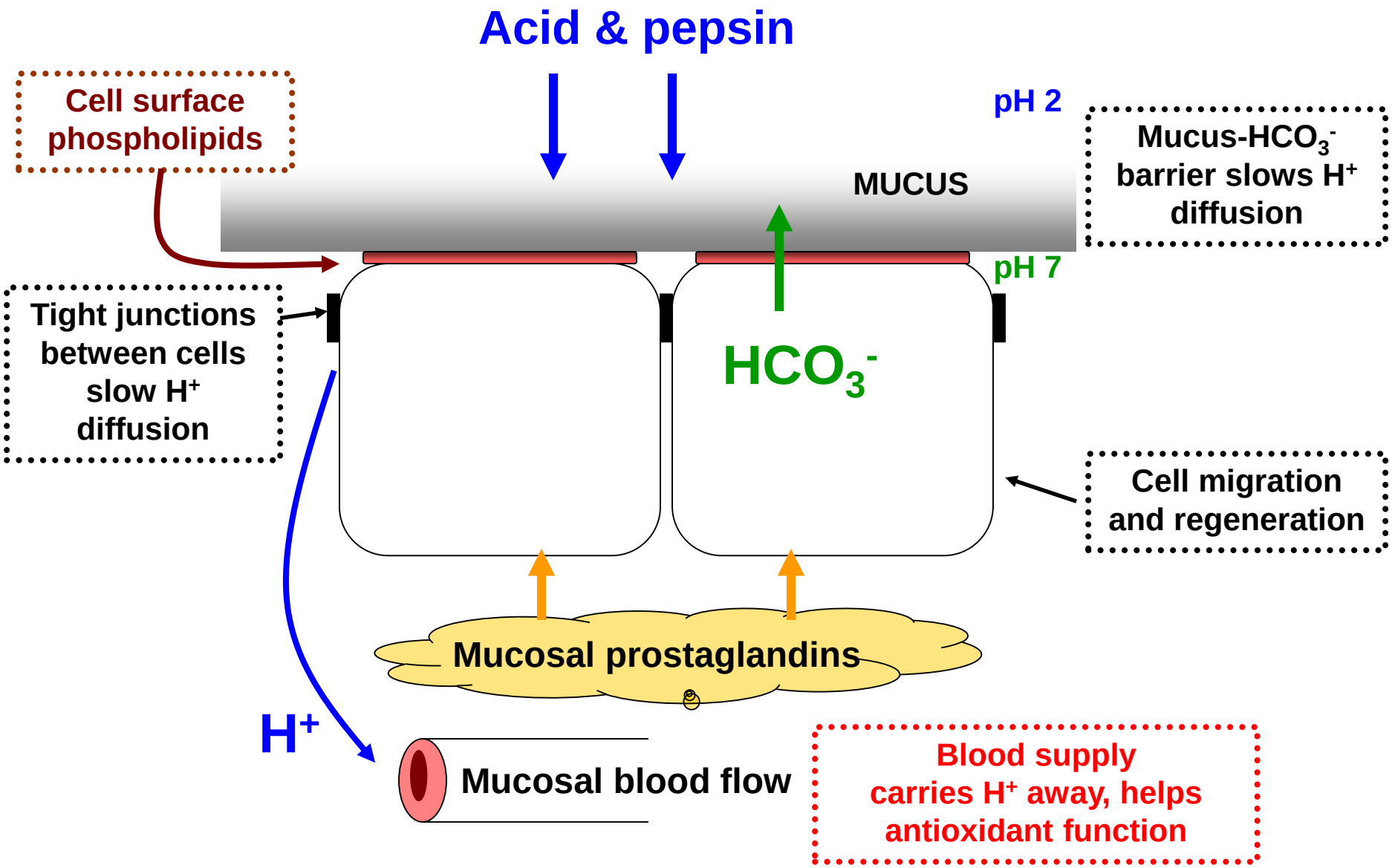


Protective

- Mucus-HCO_3
- Cell membrane
- Cell migration and renewal
- Mucosal blood flow
- Prostaglandins
- Immune system
- Acid inhibition
- Programmed cell death

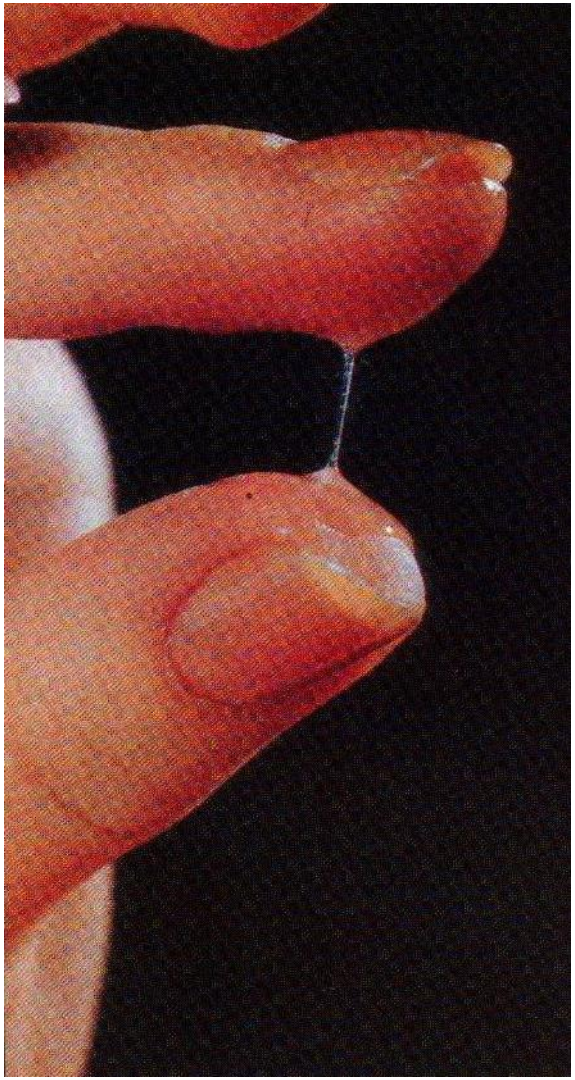
LO2
LO3

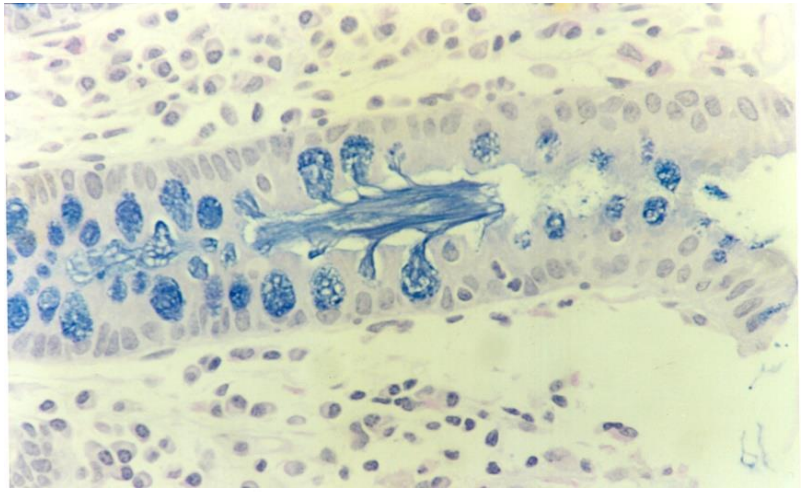
Attack and defence in the stomach



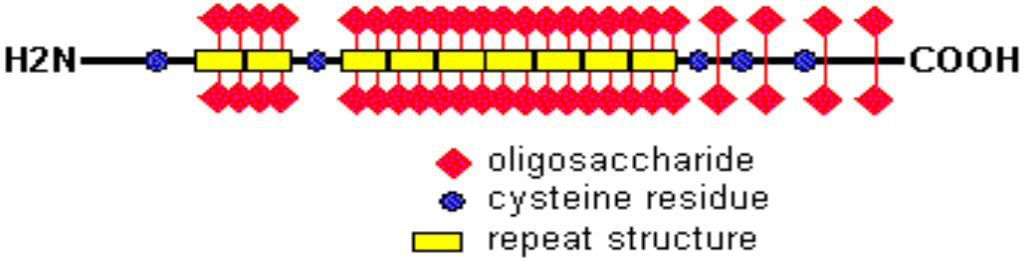
LO2

Mucus & mucins





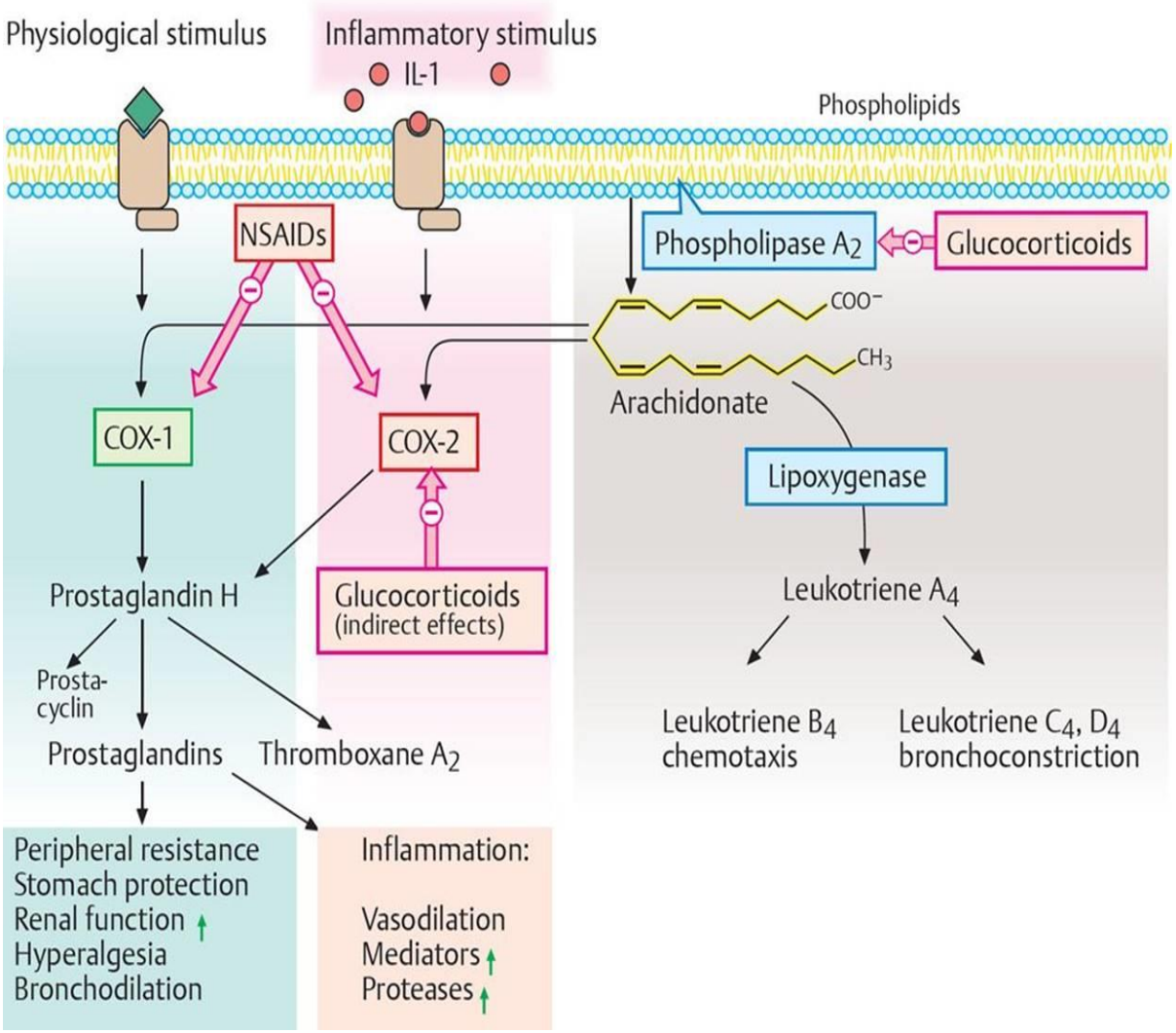
Generic structure of a mucin monomer



LO3

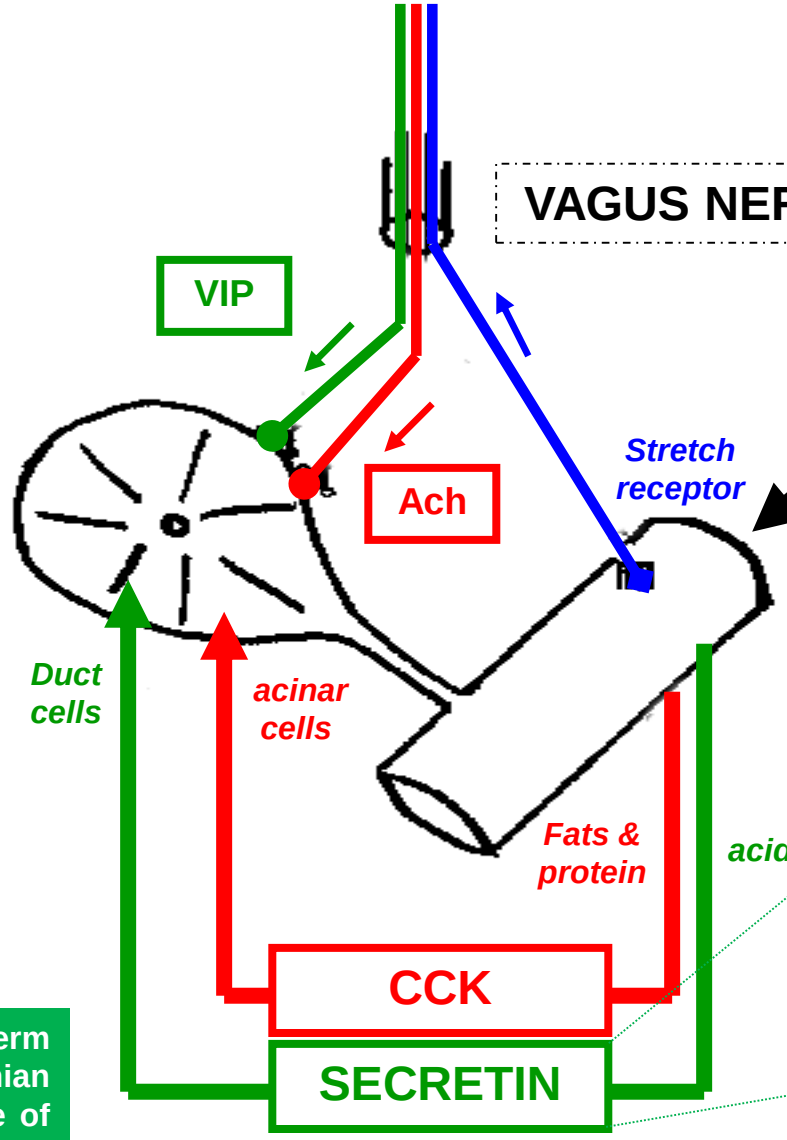
Prostaglandins (epithelial defence)

- **Regulate release of mucosal bicarbonate and mucus**
- **Maintain mucosal blood flow & epithelial restitution**
- **Inhibit histamine release from ECL cells**
- **Inhibit parietal cell secretion**



LO2
LO4

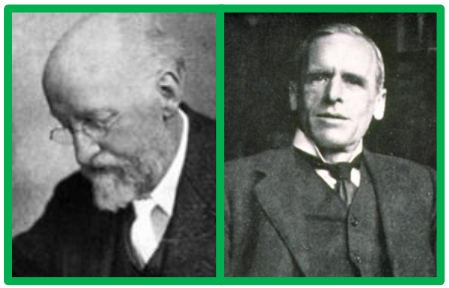
The exocrine pancreas produces bicarbonate to neutralise acidic stomach chyme



+ HCO_3^-

+ Enzymes

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

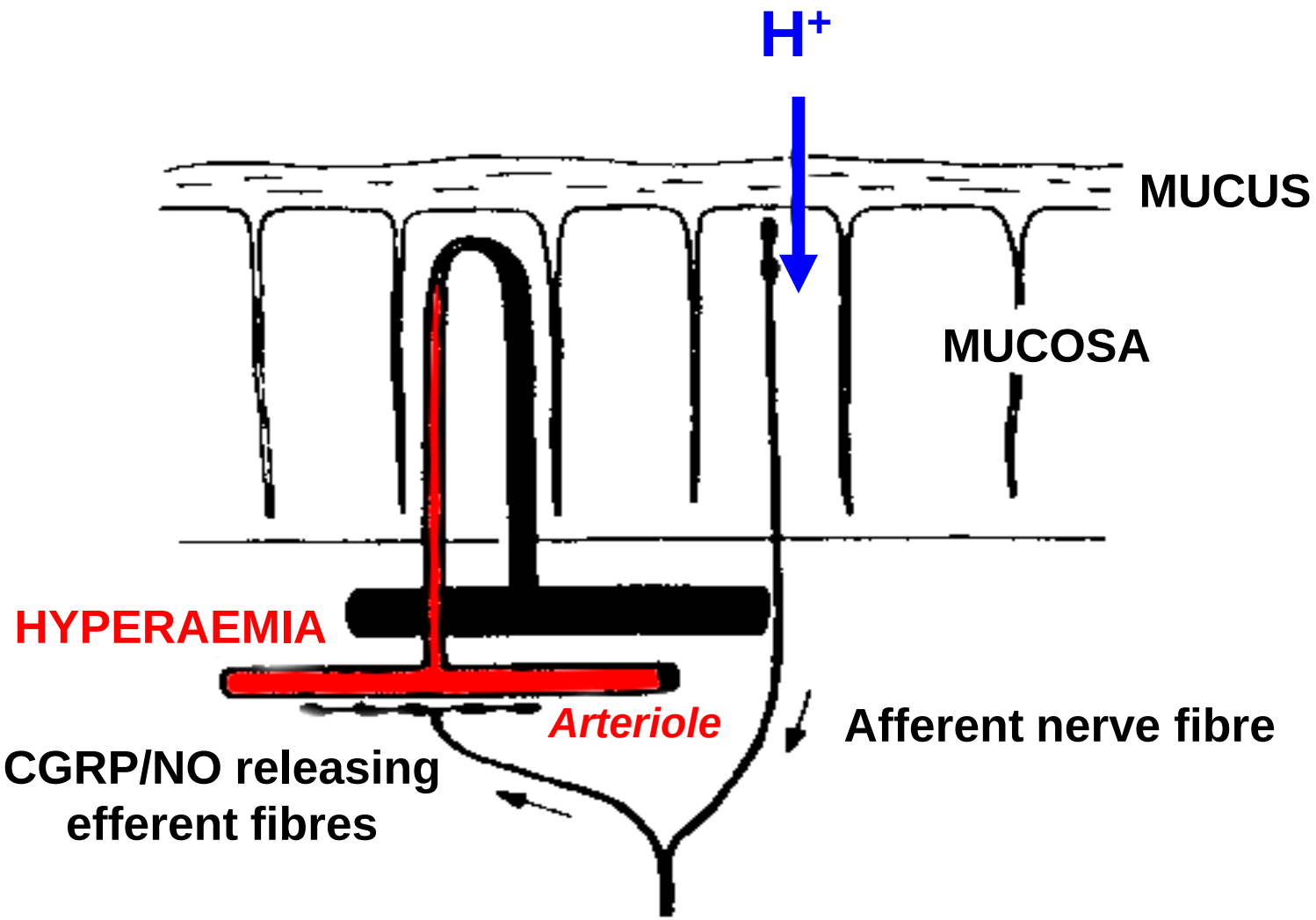


Sir William Maddock Bayliss

Ernest Henry Starling

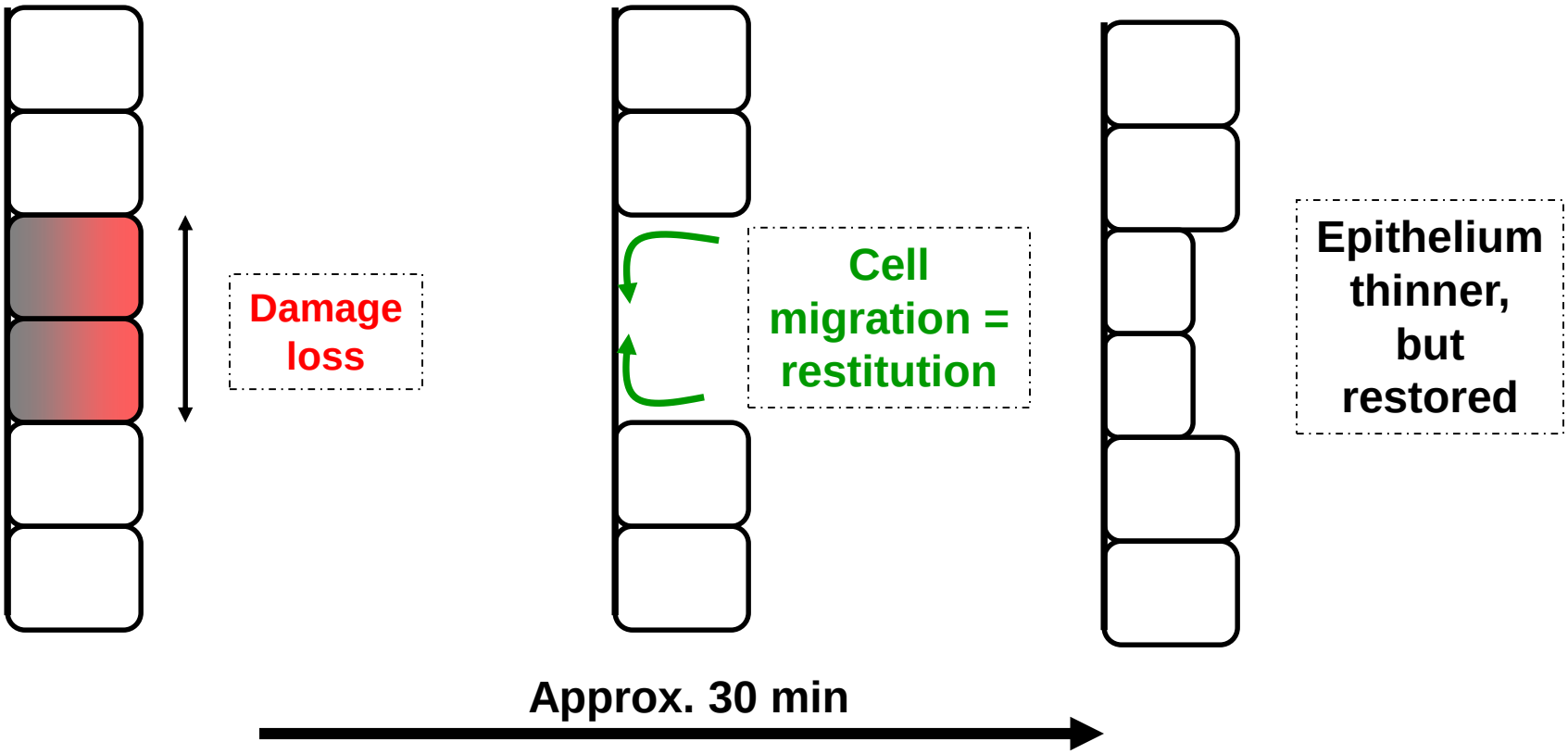
LO4

Increased blood flow in response to penetrating acid



LO5

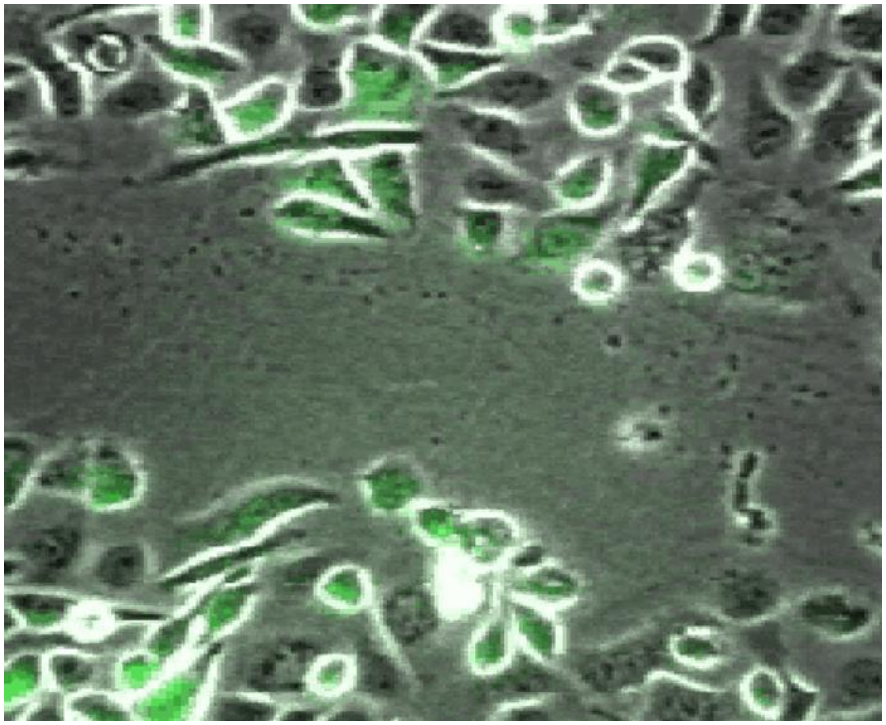
Restitution - rapid repair mechanisms

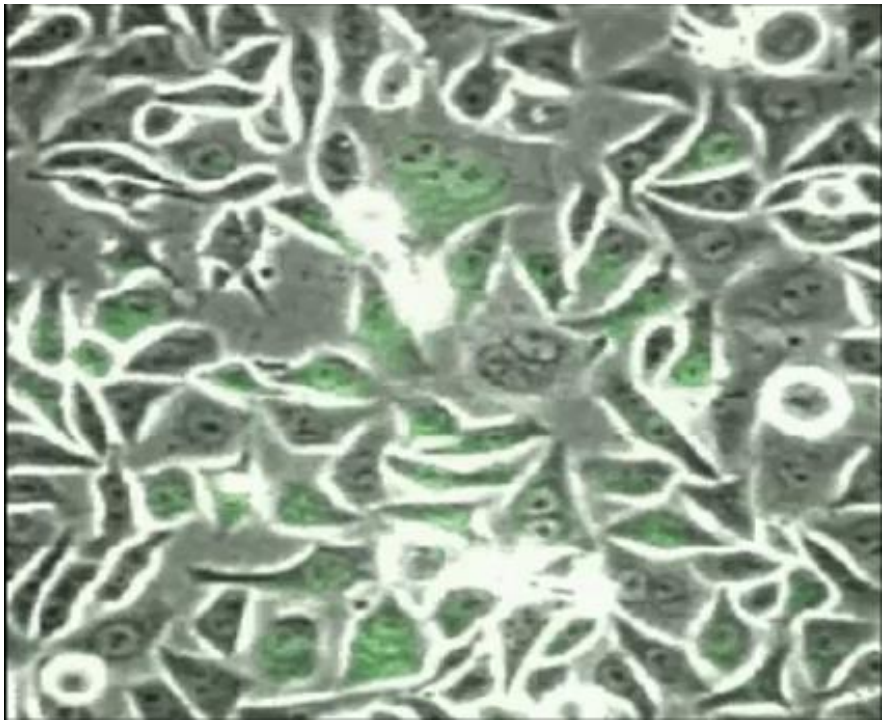


Key players in repair: Gastrin Regenerating protein (Reg)
Prostaglandins Growth factors Trefoil peptides

LO5

Gastrin stimulates migration



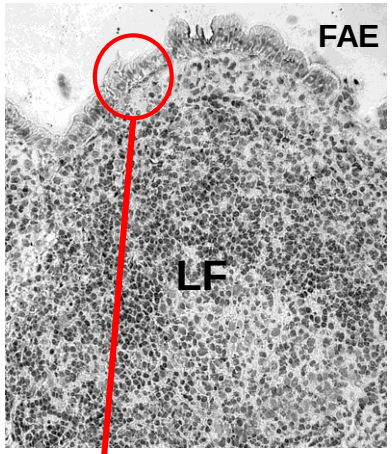


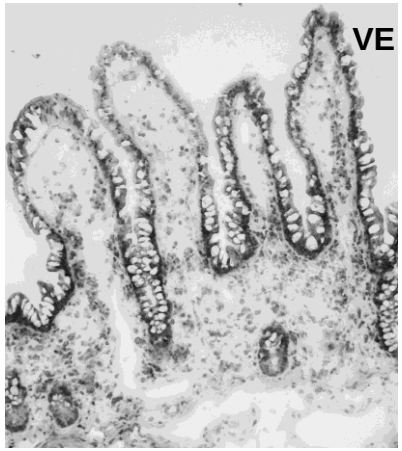
1h post addition of gastrin

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

LO6

The gut immune system: Peyer's patches

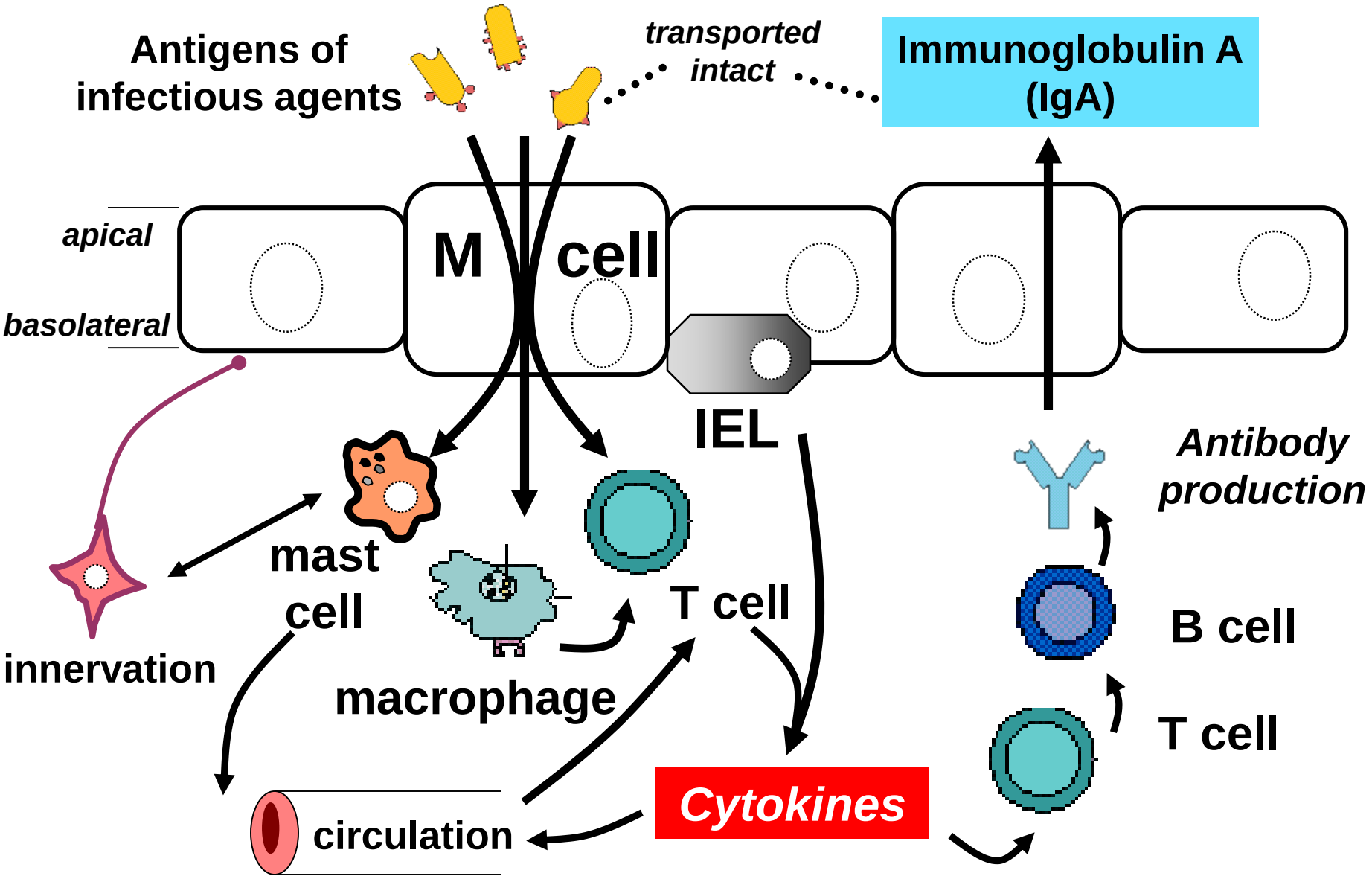




Microfold (M cells)

LO6

The gut immune system: Peyer's patches



LO7

Life and death of an enterocyte

1400 cells/villus/day

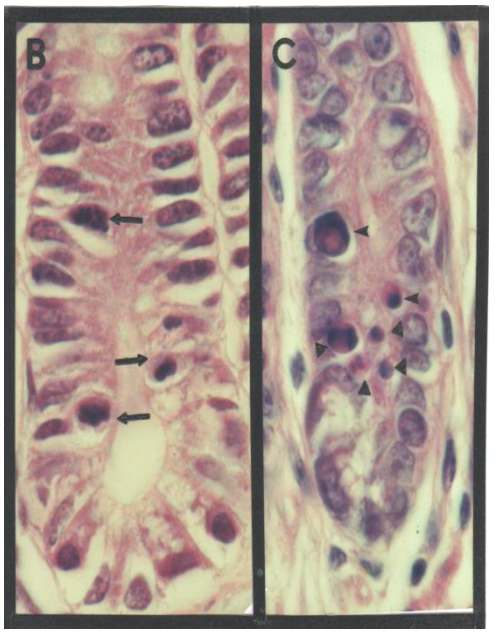
VILLUS
3500 cells

6-10
crypts/villus

300 cells/crypt/day

CRYPT
250 cells

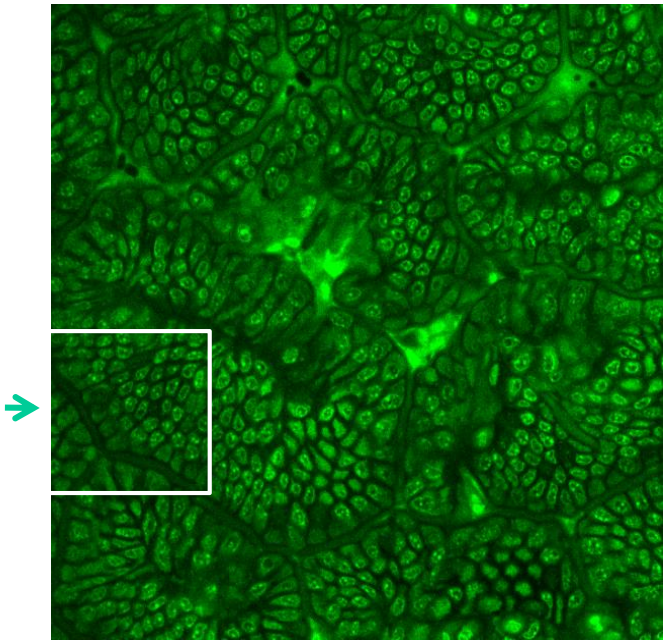
150 proliferative cells
32 clonogenic cells
<16 stem cells
paneth cells



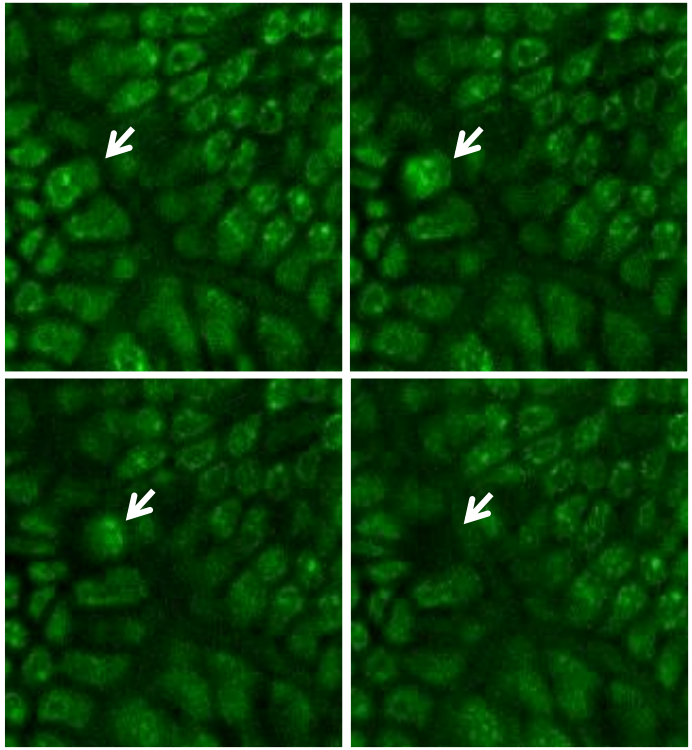
Damaged cells undergo programmed cell death (apoptosis)

LO7

Maintenance of tight junctions during cell shedding



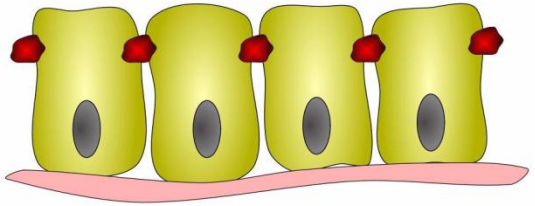
x40 objective.



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

Duckworth & Watson 2011

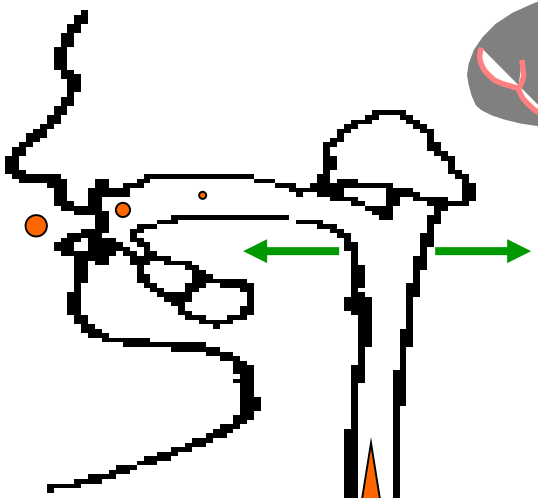
***Methods Mol. Biol.* 2011; 763, 105-114**



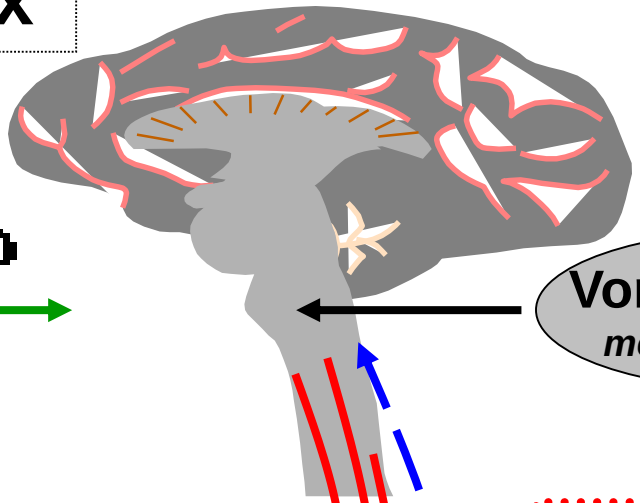
Carrie Duckworth © 2011

LO8

The vomiting reflex



Vomit

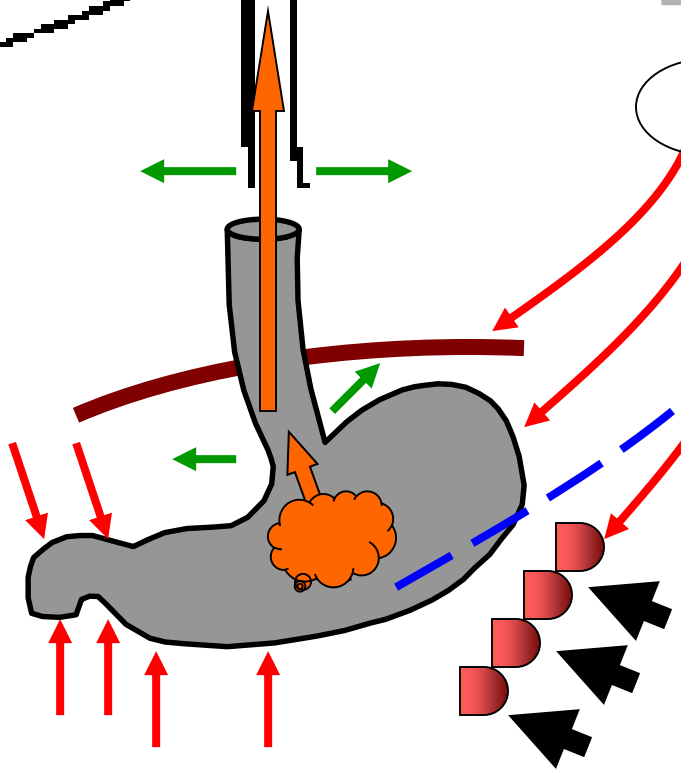


Vomiting centre
medulla oblongata

LOS, UOS & pharynx relaxed

Diaphragm fixed for inspiration

Contraction of duodenum, pylorus and antrum



Efferent fibres:
phrenic & vagus nerve

Afferent fibres:
pain, bloating, inflammation, irritants, toxins....

Intercostal muscles contracted…
High abdominal muscular pressure