Biomedicine

THE DIGESTIVE SYSTEM
1. **Alimentary/ Digestive/ Gastrointestinal Tract**

2. **Accessory Organs**

3. **Digestive Process**
1. THE ALIMENTARY TRACT

- Mouth
- Oropharynx
- Oesophagus
- Stomach
- Small intestine
- Large intestine
- Rectum
- Anal canal
2. ACCESSORY ORGANS

- 3 pairs of Salivary glands
- Pancreas
- Liver
- Biliary Tract incl. Gall Bladder
3. The DIGESTIVE PROCESS

- **Ingestion**: Oral uptake of substances into the body.
- **Secretion**: Of Digestive Juices = Water, Acid, Buffers & Enzymes
- **Mixing & Propulsion**: Churning and propulsion of food through the GI tract
- **Digestion**: MECHANICAL & CHEMICAL conversion of food into absorbable substances
- **Absorption**: Substances passing through the walls in the alimentary canal into the blood and lymph stream.
- **Elimination**: Discharge of waste and indigestible materials (Egestion: The act or process of voiding or discharging undigested food as faeces.)
ORGANS of the digestive system

- Please fill in the picture in your handout
BASIC LAYERS of the GI TRACT

- Serosa & Adventitia
- Muscularis
- Submucosa
- Mucosa
Outer Layer (Serosa): PERITONEUM

- **Largest Serous membrane in the body**
- **Loose fibrous tissue** in the abdomen
- **Closed sac**, with a small amount of serous liquid within it.
- **Parietal Layer**: lines the Cavity
- **Visceral Layer**: surrounds Organs
- **Organs are invaginated into the closed sac** (at least partly covered)
PERITONEUM

- Supplied with **many Blood** and **Lymph vessels**
- **Barrier** to local **spread** of **infection**
- **ASCITES** = An accumulation of **liquid** in the peritoneum
- **PERITONITIS** = Acute **inflammation** of the peritoneum

**C:**
Bacterial infection, Friction, Surgical wounds

**Sx:**
Pain, Tenderness, Guarding
Greater OMENTUM

- Fat Fold of Visceral Peritoneum that hangs down from the stomach.
- It extends from the Greater curvature of the stomach & passes in front of the Small intestines.
- Stores Fat
Middle Layer = Muscle Layer
MUSCULARIS

- Mostly SMOOTH, Involuntary muscles.
- SKELETAL muscle is found in the Mouth, Pharynx & Oesophagus (swallowing)
- 2 layers:
  - Inner, Circular muscle layer
  - Outer Longitudinal muscle layer
This arrangement allows for Peristalsis, Sphincter function & Churning of food

- In between:
  Blood vessels, Lymph vessels, a Nerve Plexus
SPHINCTERS & PERISTALSIS

SPHINCTER = Ring-like areas of increased numbers of Circular Muscle Fibres encircling an opening / passage in the body.

1. Act as Valves to prevent Reflux

2. Control Movement
   - Direction
   - Timing

Sphincters control movement by ordering their ‘closure - timings’

PERISTALSIS = Waves of Contraction & Relaxation that Move food forward & Mix the food.
SUBMUCOSA

- CONNECTIVE TISSUE containing Blood Vessels, Lymph Vessels & Nerves (sometimes lymphoid tissues)

http://www.lab.anhb.uwa.edu.au/mb140/CorePages/GIT/git.htm
MUCOSA

Made up of 3 Layers:

1. Mucous Epithelium
2. Lamina Propria
3. Muscularis Mucosa

Protection, Secretion, Absorption

http://www.histology.leeds.ac.uk/oral/GI_layers.php
1. Mucous Epithelium

Made up of:

- Non-keratinised, stratified, squamous Epithelium in Mouth, Pharynx, Oesophagus & Anus

- Simple, columnar Epithelium, with Microvilli & Goblet cells in the Stomach & Intestines
1. Mucous Epithelium

Mucosal Epithelium in INTESTINAL Tract

- Columnar, Epithelial cells-called **Enterocytes** with **Microvilli**
- Mucus-secreting **Goblet cells**
- Enteroendocrine cells - specialized endocrine cells of the GIT that secrete **hormones** such as *Serotonin*, *Gastrin*, *Motilin*, *Cholecystokinin*, into the blood stream
- Mucus lubricates & protects against digestive juice erosion
- Rate of renewal 3-7 days


http://histologyolm.stevegallik.org/node/411
2. Lamina Propria

- **Connective Tissue with lots of Blood & Lymph Vessels & Tissue**
- Lymphatic Tissue in the Mucosa is called **MALT** (Mucosa Assoc. Lymphoid Tissue)
  
  Since this MALT is found within the GIT it is called **GALT** (Gut Assoc. Lymphoid Tissue)
  
  ➢ GALT is present in **Tonsils, Small Intestine, Appendix & Large Intestine**

- The Lamina Propria **Supports** blood vessels, provides **Routes** for nutrients to reach other tissue & **Protects** via **MALT**

Guts’ Immune Defence
GALT/ Gut Associated Lymphoid Tissue

• Part of **MALT** (found in the Mucosa)
• GALT is **made up of several types of Lymphoid tissue** containing immune cells, such as Lymphocytes, thus providing Immune protection.
• **Peyer’s Patches** = Aggregation of GALT Located in the **lamina propria** of the **Ileum**, extending into the **Submucosa**.
• Peyer’s Patches are made up of a ‘School’ of the **White Blood Cells** (Dendritic cells, B- & T-Lymphocytes). This helps differentiate the Ileum from the Duodenum & Jejunum.

About 70% of the body's immune system is found in the Digestive Tract
GALT

Locations & Examples of GALT include:

- **Palatine Tonsils** (Waldeyer's ring)
- Small *lymphoid aggregates* in the **oesophagus**
- **Stomach** (*Lymphoid tissue* accumulating with age)
- **Peyer's Patches** ‘School’ / Aggregation of the **White Blood Cells**
- *Lymphoid Aggregates* in the **Appendix & Large Intestine**
- *Diffusely* distributed lymphoid *cells* and *plasma cells* in the **Lamina Propria** of the **Gut**
- **Adenoids** (Pharyngeal Tonsils) = ONLY MALT
3. Muscularis Mucosa

- Very thin layer of Smooth Muscle Tissue
  - Creates SMALL FOLDS which increase the surface area for Absorption & Assimilation

http://www.rci.rutgers.edu/~uzwiak/AnatPhys/Digestive_System.html
ENTERIC NERVOUS SYSTEM

• The ‘Brain’ of the gut
• 100 million Neurons - Motor, Sensory & Interneurons
• Arranged in 2 Plexuses:

Myenteric (Auerbach’s) Plexus
• Network of Sympathetic & Parasympathetic nerves within the Muscularis layer.
• Controls mainly GI Movement / MOTILITY

Submucosal Plexus
• Network of Sympathetic & Parasympathetic neurons, between the Muscularis & Submucosal Layers
• Controls Glandular/ Digestive SECRETIONS
1. **MOTOR Neurons** in the *Myenteric plexus* supply the Longitudinal & Circular Muscles of the GI tract = control Motility
   - **MOTOR Neurons** in the *Submucosal plexus* control Secretions

2. **SENSORY neurons** in the *Mucosa* act as Chemoreceptors & Stretch Receptors
   - **INTERNEURONS** connect the 2 plexuses

http://www.as.miami.edu/chemistry/2086/Chap%2024/Chapter%2024-newPART1.htm
Although the ENS can function independently it is REGULATED by the AUTONOMIC NERVOUS SYSTEM.

The Sympathetic & Parasympathetic Nerves synapse with the neurones in the Submucosal & Myenteric Plexuses.

<table>
<thead>
<tr>
<th>PARAsympathetic (Rest &amp; Digest)</th>
<th>SYMpathetic (Fight or Flight)</th>
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<tbody>
<tr>
<td>↑ Muscular Activity esp. Peristalsis (Myenteric plexus)</td>
<td>↓ Muscular activity esp. Peristalsis (Myenteric plexus)</td>
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<tr>
<td>↑ Glandular Secretion (Submucosal plexus)</td>
<td>↓ Glandular secretion (Submucosal plexus)</td>
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BLOOD SUPPLY

• Supplied from branches of the AORTA
VENOUS Drainage

PORTAL VEIN drains blood from:

- Lower part of the Oesophagus
- Stomach
- Pancreas
- Small Intestine
- Large Intestine
- Part of the Rectum.
- Spleen

ILIAC VEINS drain blood from:

- Lower part of the Rectum
- Anal canal
Digestive System Organs In Detail

Anatomy, Physiology & Pathology of the Upper Digestive System
The TONGUE

- Voluntary muscle structure, attached to Hyoid Bone
- Lingual Frenulum - attaches it to the floor of the mouth
- Superior surface covered with Papillae containing Taste Buds
- Functions of the tongue:
  - Mastication
  - Swallowing
  - Speech
  - Taste
The TEETH

- **32** teeth complete by about 24 years
- **20** temporary teeth

STRUCTURE of a Tooth:
- **Crown, Neck & Root**

FUNCTION:
- **Biting** off pieces of food and mastication
SALIVARY GLANDS

- Small glands open directly into the mouth
- Secrete Saliva
- Major salivary glands =
  - Parotid gland
  - Submandibular gland
  - Sublingual gland
Composition & Function of SALIVA

Main CONSTITUENTS:

1. Water- **99.5%**
2. Mineral Salts (Na, K, Ca, Cl, Bicarb, P)
3. Enzymes: Salivary Amylase (parotid), Lysozyme
4. Mucus
5. Immunoglobulins (IgA)
6. Blood Clotting Factors

FUNCTION

1. Chemical Digestion of polysaccharides (using Amylase- starch enzyme)
2. Lubricating & Dissolving food
3. Cleansing of oral cavity and teeth
4. Non-specific Defence – IgA & Lysozymes
5. Taste
6. pH 6.35-6.85
7. Removes Waste products
• Secretion of saliva is a REFLEX & can be conditioned.
• Controlled by the ANS
• Parasympathetic stimulates promotes salivation
• Sympathetic nervous stimulation – reduces salivation - Dryness of mouth (thicker saliva)
• FEEL and TASTE of food stimulate nucleus in the Brain Stem
• Return via Facial & Glossopharyngeal Nerve (Cranial Nerves VII & IX)
• 1- 1.5 L/day
• Reabsorb most of the fluid
• Conservation of water via the ‘Thirst Reflex’ (via Hypothalamus)
Digression: Carbohydrates

- **MONOSACCHARIDES**
  - Glucose, Galactose, Fructose

- **DISACCHARIDES**
  - Maltose, Sucrose, Lactose

- **POLYSACCHARIDES**
  - Starch
  - Glycogen
  - Cellulose
Digression: Enzymes

- Enzymes are **CATALYSTS** for Biochemical Reactions.

- They **SPEED UP** the reaction but they are **NOT CHANGED THEMSELVES**.

- Enzymes can:
  - **SYNTHESISE**
  - **BREAKDOWN**

- Their names usually end in **-ase**
Digression: **Enzymes**

- The substance they **work on** is called the **Substrate**.
- They are **specific for their substrate**.

- They are also **Temperature** and **pH** specific.

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**Diagram:**
- **Enzyme activity** graph showing variations in **pH** and temperature.
  - Salivary amylase is most active around pH 6.
  - Pepsin is most active in the acidic range (pH 1 to 3).
  - Arginase is most active in the basic range (pH 10 to 12).

**Process steps:**
- **Substrate entering active site of enzyme**
- **Enzyme substrate complex**
- **Enzyme/products complex**
- **Products leaving active site of enzyme**

**Legend:**
- **Active site**
- **Enzyme changes shape slightly as substrate binds**
- **Products**
Digression: pH

- **Acids, Alkalis & pH**
- The **body has to maintain optimal pH concentrations for certain reactions to take place**!!
- The pH Scale *is a measurement of the hydrogen ion concentration in a solution*. This is what we commonly call ACIDITY.
- This scale was developed using **water** as a standard because Water has equal number of H+ and OH- ions (H+ + OH- = H2O)
- **Neutral = 7 (Water)**

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- **Blood = 7.35 - 7.45**
- **Saliva = 5.4 - 7.5**
- **Gastric Juice = 1.5 - 3.5**
- **Bile = 6.00 - 8.5**
- **Urine = 4.5 - 8.0**
BUFFERS

- **Optimum pH** is maintained by ‘Buffering Systems’ which **balance** acids & alkalis
- Organs of Buffering = **Kidneys & Lungs**

1. **Lungs:** *Use CO2*

2. **Kidneys:** *Use Hydrogen and Bicarbonate*

Some **buffers bind H+ ions (acidity)** and others **bind OH- ions (alkali)**

\[
H^+ + HCO_3^- \rightarrow H_2CO_3
\]

Hydrogen+ Bicarbonate ion $\rightarrow$ Carbonic **acid**

OR

\[
OH^- + H_2CO_3 \rightarrow HCO_3^- + H_2O
\]

Hydroxyl + Carbonic $\rightarrow$ Bicarbonate + Water acid
**RECALL: PHARYNX**

- **Nasopharynx**: Airway, Auditory tubes & Adenoids/Pharyngeal Tonsils

- **OROPHARYNX**: Palatine Tonsils

- Laryngopharynx
OESOPHAGUS

- Passes through **Diaphragm**
- **Deep** to **Trachea**
- Muscles provide **Peristalsis**
- **Epiglottis:** *Prevents food passing down wind pipe*
- **Lower Oesophageal Sphincter**
  - Acts as a seal on the stomach to prevents reflux
OESOPHAGUS

• Walls are lubricated by MUCUS

• Venous Drainage:
  ➢ The majority of blood from the Oesophagus is drained via the Oesophageal Veins, which drain into the Azygos vein, which in turn drains directly into the Superior Vena Cava.
  ➢ Lower part drains into the Left Gastric vein then the Portal Vein & Inferior Vena Cava
Stages of Swallowing (Deglutition):

1. **Formation of a BOLUS** - formed via **mastication & mixing** of food with juices.
2. **Mouth Closed** - Bolus pushed by tongue into **Pharynx**
3. **Pharynx Reflex Action** - Soft palate (Uvula) **closes** the Nasopharynx & the Epiglottis **occludes** the Trachea
4. **Bolus** of food in pharynx then stimulates **Reflex of Peristalsis** in the Oesophagus
5. **The Cardiac sphincter** (Lower Oesophageal sphincter) **relaxes**
DIGESTIVE SYSTEM PATHOLOGIES
General Signs & Symptoms
Relating to GIT Pathologies

- Dyspepsia & Indigestion
- Nausea & Vomiting
- Flatulence
- Diarrhoea
- Constipation
- Weight loss
- Abdominal Pain

RED FLAG Symptoms

- DYSPHAGIA – Difficulty swallowing
- WEIGHT LOSS for no reason
- Protracted VOMITING
- ANOREXIA
- HAEMATEMESIS – Vomiting fresh red blood
- MELAENA – Black, tar-like stools

(Not Haematochezia - Bright, Red blood in Stools = Piles / fissures etc.)
INVESTIGATIONS of the GIT

• Barium Contrast studies
• X-rays
• Ultrasound
• MRI
• Stool samples
• Sigmoidoscopy, Endoscopy, Colonoscopy
• Palpation
DISEASES OF THE MOUTH
ORAL THRUSH

**Sx:**
- Transient white patches,
- Inflammation & Soreness of mouth.

**Cause:**
- Usually *Candida albicans* (fungus) in disturbed mouth flora seen in cases of Suppressed Immunity or after Antibiotics.
- Common in bottle-fed babies

**Differential diagnosis:**
Coated tongue (Mouth swab)

**Rx:**
- Anti-fungals
- Hygiene
- Restoration of Mucosal Flora

**Compl:**
- Intestinal Thrush
MOUTH ULCERS
(Oral Ulceration)

**Sx:**
- Broken skin inside mouth that Ulcerates,
- Generally Painful

**C:**
- Often Fe, Zn or Vit. B12 Deficiency,
- Can be related to gut problems e.g. CROHN’S
- Drugs, Viral infections, Trauma, Stress, SLE (lupus),
- Wrong toothpaste or mouth wash,
- Allergy.

**Rx:**
- Supplements & Gut Flora Restoration,
- TREAT THE UNDERLYING CAUSE
ABSCESS

• Localised pocket of infection / pus surrounded by inflammation, can occur anywhere in body.

• It is a defensive reaction of the tissue to prevent the spread of infectious materials to other parts of the body.

• (A Boil/furuncle is a type of skin abscess which is always assoc. with a Hair Follicle)
ANGULAR CHEILITIS

**Sx:** Cracked Mouth Corners

**C:**
- Candida albicans, Staphylococcus,
- Lack of **Iron**, vitamin B2, B6 or Folic acid (B9)
- Common in Immune- Suppressed people

**Rx:** According to Cause

http://www.123tagged.com/Tags/1/angular-cheilitis.html
COLD SORES
(Acute Herpetic Gingivostomatitis)

**Sx:**
Painful vesicular lesions around mouth/nose, that ulcerate, scab then heal

**C:** Herpes Simplex Virus

**Rx:** Acyclovir, Lemon Balm, Black Elderberry, Oxypro, Active Silver, Propolis, L-Lysine
XEROSTOMIA
(Dry Mouth)

Causes:
• Sjogren’s syndrome (autoimmune attack of tear / saliva glands)
• Drugs (antidepressants)
• Radiotherapy
• Psychogenic causes
• Dehydration
• Shock
• Renal Failure
• Hormonal Imbalance
CONGENITAL DEFECTS

CLEFT LIP (HARELIP)
- Malformation of Lip / skin tissue in embryonic development
- 1:6/800 births
- Unilateral/Bilateral
- Complete/Incomplete

CLEFT PALATE
- Malformation of the hard palate in embryonic development
- Difficulty – Speech, hearing, feeding
- Usually requires surgery

Suspected Causes include:
1. GENETIC Defects
2. ENVIRONMENTAL - Maternal diseases, Dietary factors
3. TERATOGENS = Chemotherapy, Radiation, Alcohol, excess vit. A, Anticonvulsant medications, Smoking, Substance abuse

Risk Factors:
1. PREGNANCIES in women > 35yrs OR TEENAGED PREGNANCIES
2. ↑ consumption of TERATOGENS in EARLY months of PREGNANCY
TUMOURS of the MOUTH

Sx:
• Difficult to diagnose
• Any ulcer in the mouth that will not heal
• Common in smokers!
SALIVARY CALCULI

“Wherever juices flow stones can grow.”


C: Inflammation
   Often Dehydration -not enough drinking- in old people.

Rx: Operation

Submandibular Sialolithiasis

MUMPS

Infection & swelling of the Parotids

**Cause:**
- Paramyxovirus

**Sx:**
- **Swelling:** One or both sides of the face
- **Extreme pain in the throat**
- **Fever & Malaise**
- **Occasionally Orchitis (Testicular swelling)**

**Rx:**
- **Bed Rest & Plenty to drink**
- **Paracetamol** for the fever and pain
TONSILLITIS

Inflammation of the Palatine Tonsils

Sx:
- Redness, Soreness & Pain of the Tonsil
- Pus formation
- Lymphoedema

C: Can be Streptococci infection

Complications:
1. Endotoxins of Streptococcal infection can cause Rheumatic Fever
2. Chronic Tonsillitis can act as a local focus of infection causing repeated infections, keeping immune system on alert / spreading.

Rx:
1. Antibiotics in case of streptococci
2. Tonsillectomy
OESOPHAGEAL VARICES

Varicose veins of the Oesophagus

**Sx:**
- Slight bleeding (occult blood in stool)
- Anaemia +/- Iron Deficiency

**Causes:** (The problem always occurs before the place of congestion!)
- Liver Cirrhosis
- Right Heart Failure

**Compl:**
- Rupture & Bleeding
HIATUS HERNIA

Protrusion of the upper part of the STOMACH into the thorax through a tear or weakness in the DIAPHRAGM.

Sx: Usually none, but can lead to...

• Heartburn
• Regurgitation of food
HIATUS HERNIA

Causes:
• Increased PRESSURE within the abdomen caused by:
  – Heavy lifting or frequent bending over
  – Frequent or hard coughing/sneezing
  – Pregnancy and delivery
  – Violent vomiting
  – Straining with constipation
  – Obesity
• Heredity
• Smoking/Drug abuse
• STRESS

Complications: See GORD

Rx: Treat Cause, Surgery
PEPTIC REFLUX OESOPHAGITIS

AKA

GORD = Gastro-Oesophageal Reflux Disease

**GORD/ GERD = A condition of the Oesophagus whereby Stomach acid leaks back up into it. (Acid Reflux into the Oesophagus).**
Repeated episodes of GORD inflame the oesophageal lining—thus referred to as Oesophagitis

**Sx:**
- Pain behind Sternum
- Heartburn aggravated by bending, laying down, relieved by Antacids
- Regurgitation of food

**Differential Diagnosis:**
- Angina
- Bulimia
OESOPHAGITIS / GORD

Causes

• Dysfunction of Lower Oesophageal Sphincters
• Hiatus Hernia
• Trigger Foods
• Stress
• High Acidity = Alcohol, Smoking, Acidic diet
• High intra abdominal Pressure = Overweight, Pregnancy

Trigger Foods

• Spices, Fatty /Fried foods
• Alcohol
• Caffeine
• Citrus
• Chocolate – relaxes the oesophageal sphincter
• Tomatoes
• Garlic
• Onions
• Mint
• High Sugar
• Fizzy drinks
OESOPHAGITIS / GORD

Rx:
• Antacids,
• Changing Lifestyle,
• Losing weight

Th / Management:
Remove aggravating food & increase soothing foods such as Oats, Aloe vera, Slippery elm, Camomile tea

Complication:
Damage to Oesophageal Mucosa e.g. Ulcers, higher risk of Oesophageal Cancer
TUMOURS of the Oesophagus

- 8-10% of all cancers
- More common in men

**Sx:** Few early symptoms, later obstruction

**C:** Chronic irritation, alcohol, smoking

Poor Prognosis
THE STOMACH

Structure:
- Cardiac Sphincter
- Fundus
- Body
- Pyloric Antrum
- Pyloric sphincter (relaxed in empty stomach)
- Greater curvature
- Lesser curvature
MUSCULARIS
- 3 layers of Smooth Muscles = Longitudinal, Circular & Oblique
- For Churning and Peristaltic movement.

MUCOSA
Epithelium = Simple Columnar Epithelium with Secretory cells making up Gastric Glands with Gastric Pits (Ducts of the Gastric Glands)

Secretary Cells within the Mucosa:
- Goblet Cells (Mucous)
- Parietal Cells (HCL & Intrinsic Factor)
- Chief Cells (Pepsinogen)
- G Cells (Gastrin)
1. **CEPHALIC Phase** – Sight, Smell, Taste & Thought stimulate stomach secretions through Vagus nerve

2. **GASTRIC Phase** – Food in the stomach stimulates the Stomach and the Duodenum to secrete Gastrin - a hormone which Stimulates Gastric Juices. Gastrin is suppressed when Antrum = pH 1.5 (Acidic)

3. **INTESTINAL Phase** - When food reaches the Duodenum: Secretion of Enterogastrone = Secretin + Cholecystokinin (CCK) - Slow down gastric juice secretion + motility & Neutralizes stomach acid

Now **BOLUS** of food is referred to as **CHYME**

**Passage time**: Depending on food
Gastric Juices

~ 2L per day, consisting of:

- **Water & Mineral salts**

- **Mucus**: (Goblet cells): Protects stomach lining from gastric Juices.

- **Gastrin**: Hormone secreted by G cells in the Stomach, Duodenum & Pancreas. Stimulates Gastric juice Secretion

- **Hydrochloric Acid**: Secreted by Parietal cells. Acidifies food, Kills microbes and Activates pepsinogen to pepsin

- **Pepsinogen/ Propepsin**: Formed in the Chief cells of the mucous membrane of the stomach. Pepsinogen = Inactive Enzyme Precursor to Pepsin (Active Enzyme which starts protein digestion)

- **Intrinsic Factor**: Secreted by Parietal cells Necessary for Vit. B12 absorption in the small intestine
• Made up of **Amino acids** (Building Blocks)
• Proteins are the **main structural molecules** of the body
• **Proteins vary** enormously in **SIZE & FUNCTION** e.g.
  – **Carrier Molecules** (Haemoglobin, Albumin)
  – **Enzymes**
  – **Some Hormones** (Insulin)
  – **Antibodies**
  – **Neuropeptides**
• Can act as an **Alternative energy source** (less efficient)
• **PEPSIN** = Enzyme which **Breaks** down **Protein**
• Most effective at **pH 1.5 – 3.5**
Recall: Vit. B12 & Intrinsic Factor

- **INTRINSIC FACTOR** = Glycoprotein produced by the Parietal cells of the stomach,
- **Binds with B12- in the small intestine, attaching to specific** $B_{12}$ **intrinsic factor- receptors in the mucosa of the Terminal Ileum (D, J, I), allowing for** $B_{12}$ **absorption & entry into the Portal Circulation**
- The optimum pH for IF’s action = 7, so it has no relation to the amount of HCl or Pepsin in the gastric juice.
- So in some cases, the intrinsic factor may be present even if there is **NO** HCl or Pepsin or vice versa.

http://path.upmc.edu/cases/case428/dx.html
FUNCTIONS of the STOMACH

1. Temporary **Storage** before the food is released into the Duodenum

2. **Chemical Breakdown - Pre-digestion of Proteins** (proteins to polypeptides)

3. **Mechanical Breakdown**

4. Limited **Absorption** of Water, Alcohol, Lipid-soluble drugs.

5. Non-specific **Defence** against microbes

6. **Preparation** of **Iron** for absorption - **Solubilises**

7. **Intrinsic Factor** for vitamin B12 absorption
PATHOLOGIES of the STOMACH

http://www.inds.co.uk/anatomy/digestive.htm
ACUTE GASTRITIS

Inflammation of Stomach Mucosa

Sx:
• Dull Pain – mostly WORSE with food INTAKE
• Sickness / Vomiting
• NO APPETITE

C:
Mostly irritating substances such as Alcohol, Drugs, Food poisoning…

Compl: Heavy Bleeding

Rx: Removing cause
CHRONIC GASTRITIS

Gastritis that occurs for LONGER than 4-6 WEEKS

**Sx & Signs:** Sometimes *very few symptoms*,
- REDUCED Gastric Juices – often Microbial Infection
- Feeling FULL after meals, Problems digesting heavy meals
- Megaloblastic / Pernicious or Iron def. Anaemia

**Cause:**
- **Helicobacter Pylori** or
- **Autoimmune** (Pernicious Anaemia-
- Often in Older people
- **PROLONGED** Acute Gastritis

**Rx:** Diagnose and **eradicate Helicobacter or underlying cause**, see acute gastritis
PEPTIC ULCERATION

‘Peptic’ = Belonging to the digestive system

Tissue damage down to the SUBMUCOSA or MUSCLE LAYER in:

1. Stomach or
2. Duodenum or
3. Oesophagus.
PEPTIC ULCERATION

Cause:
- NSAIDs,
- Chronic Gastritis,
- Helicobacter Pylori.
- Typically in sensitive people with sensitive Autonomic NS often causing Ischaemia (stress constricts blood vessels) i.e. STRESS!!

Sx:
- Localised Pain, mostly when stomach is EMPTY (Before & 3 hours after eating) and at NIGHT.
- Often Burping, Nausea, Bad Reaction to irritating Food (alcohol, coffee, sweets, spicy food, garlic, onions, fatty/fried food, Citrus, Fizzy drinks etc.)

Rx:
- Diet,
- Antibiotics - Helicobacter eradication
- Stress Reduction.
- Antacids/ Proton Pump inhibitors
PEPTIC ULCERATION

Complications:

1. BLEEDING = Anaemia
   - **Capillary Bleed**: Blood in Stool
     - l.t Anaemia
   - **Major Arterial Bleed**: Blood in Vomit = **Haematemesis** (Ground Coffee) or Blood in Stool (tar black)
     - l.t shock

2. PERFORATION / RUPTURE:
   - **IMMEDIATE** severe Pain, HARD TUMMY, ACUTE ABDOMEN

Rx: 999, do NOT move patient !!
DUMPING SYNDROME

Loss of control of Gastric Emptying Triggers the pancreas to release EXCESSIVE amounts of INSULIN

Cause:
• Cholecystectomy
• Gastric Bypass
• Gastrectomy
• Oesophagectomy

http://po-ny.jogger.pl/2008/03/01/gastric-bypass-a-co-to©
**DUMPING SYNDROME**

**Symptoms:** (depends on TIMING)

**EARLY Dumping**  
(Straight after meal)  
- Nausea, Vomiting,  
- Bloating, Cramping,  
- Diarrhea,  
- Dizziness and Fatigue.

**LATE Dumping**  
(1-3hrs after meal)  
- Weakness, Sweating and Dizziness

**Rx:**  
- **Avoid** SUGAR!  
- **Avoid** LIQUID with meals,  
- FREQUENT HIGH PROTEIN - low carb meals,  
- SURGERY
TUMOURS of the Stomach

**Sx:**
- *First:* Few symptoms only, gastritis pain is possible
- *Later:* disgust for certain foods (sometimes meat) weight loss, lymph node swelling

**C:** Predisposition, irritating diets, other stomach diseases

**Diagnostic:** Blood in stool, tumour marker (M2-PK in stool)

**Compl:** Spread - lymphatic, blood, peritoneal
Quiz Time!

• Teams of 4
• Decide on a team name
• 45 Questions
• Possible 40 marks
• Write neatly so the marking team can read you answers!