Week 1 – The GI Tract

Digestion - the breakdown of food to small enough components which can then be absorbed

The GI tract is a flexible muscular tube, that extends from the mouth through the esophagus to the stomach, small intestine, large intestine and rectum to the anus.
The inside of the GI tract is the lumen which is continuous from one end to the tract to the other.

Only once a nutrient or other substance penetrates the wall of the tract is it absorbed, many materials pass through the tract without being digested or absorbed.

Mouth

Where digestion begins, mechanically with chewing, the teeth crush larger bits of food into smaller, fluids from foods, beverages and the salivary glands are used to blend with and ease swallowing.
Once swallowed, food passes the pharynx, belongs to both the digestive and respiratory system.
To bypass entry to the lungs, the epiglottis, closes off the air passages so the person does not choke as they swallow.
Once swallowed, a mouthful of food is a bolus.

Oesophagus to stomach

Oesophagus - spinchter muscle at each end.
During a swallow, the upper oesophageal sphincter opens. The bolus then slides down the oesophagus, which passes through a hole in the diaphragm to the stomach . The lower oesophageal sphincter at the entrance to the stomach closes behind the bolus so that it proceeds forward and doesn't slip back into the oesophagus. The stomach retains the bolus for a while in its upper portion. Then, bit by bit, the stomach releases the chyme through the pyloric sphincter , which opens into the small intestine and then closes behind the chyme.

Small intestine

At the beginning of the small intestine , the chyme bypasses the opening from the common bile duct, which is dripping fluids into the small intestine from two organs outside the GI tract – the gall bladder and the pancreas . The chyme travels on down the small intestine through its three segments – the duodenum , the jejunum and the ileum – over three metres of tubing coiled within the abdomen. Small intestine

Large intestine (colon)

Having travelled the length of the small intestine, the remaining contents arrive at another sphincter: the ileocaecal valve , located at the beginning of the large intestine (colon) in the lower right side of the abdomen. Travel along the large intestine up the right side of the abdomen, across the front to the left side, down to the lower left side and finally below the other folds of the intestines to the back of the body, above the rectum .
As the intestinal contents pass to the rectum, the colon withdraws wate. The strong muscles of the rectum and anal canal hold back this waste until it is time to defecate.

o Enzyme replacement therapy – administered at meals containing protein &/or fat. Not needed for meals with little or no fat.
Þ Dietary guidelines for cystic fibrosis:
o Similar to the healthy population, with some distinct differences
o Chose a nutritious, high-energy diet from a wide variety of foods.

o Eat plenty of fat & sugar
o Eat more breads, cereals, meats, protein foods & milk products
o Use plenty of salt

The endocrine pancreas:

• The endocrine portion of the pancreas takes the form of many small clusters of cells called Islets of Langerhans.
• Pancreatic islets house three major cell types, each of which produces a different endocrine product – Alpha, Beta & Delta cells.
• Alpha cells (α- cells) secrete the hormone glucagon.
• Beta cells (β-cells) produce the hormone insulin and are the most abundant of the islet cells
• Delta cells (D cells) secrete the hormone somatostatin, which is also produced by a number of other endocrine cells in the body. Somatostatin inhibits the secretion of glucagon & insulin.

Pancreatic hormones:

➢ In a fed state, insulin dominates glucagon. There is an increase in glucose oxidation (glycolysis), glycogen synthesis, fat synthesis & protein synthesis.
➢ In a fasted state, glucagon dominates insulin. There is an increase in gluconeogenesis (synthesis of new glucose from non-carbohydrate substrates such as protein), glycogenolysis (glucose released from the breakdown of glycogen) & ketogenesis (the creation of ketone bodies from the breakdown of fatty acids).

Insulin:

Þ Structure of Insulin: Insulin is a protein (and a hormone), composed of two chains held together by disulfide bonds.
Proinsulin (the precursor of insulin) consists of 3 domains:
o An amino-terminal B chain
o A carboxy-terminal A chain
o A connecting peptide in the middle known as the C peptide
Þ Functions of Insulin:
o Decreases hepatic (liver) glucose production
o Decreases lipolysis (the breakdown of fats into fatty acids occurring in adipose tissue)

o Increases peripheral (muscular) uptake of glucose
Þ Targets of Insulin Action:
Carbohydrates:
o Increased activity of glucose transporters (which move glucose into cells).
o Activation of glycogen synthase (a key enzyme in the conversion of

Essential fatty acids
The human body needs fatty acids, and it can make all but two of them – linoleic acid (the 18-carbon omega-6 fatty acid) and linolenic acid (the 18-carbon omega-3 fatty acid). These two fatty acids must be supplied by the diet and are therefore essential fatty acids .

Storing fat as fat
When meals deliver more energy than the body needs, the excess is stored as fat in the adipose cells for later use. An enzyme – lipoprotein lipase (LPL) – hydrolyses triglycerides from circulating lipoproteins, releasing fatty acids, diglycerides and monoglycerides into the adipose cells. Enzymes inside the adipose cells reassemble these fatty acids, diglycerides and monoglycerides into triglycerides again for storage. Triglycerides fill the adipose cells, storing a lot of energy in a relatively small space. This accumulation of fat in adipose tissue represents a key advantage that allows humans to survive through times when food is unavailable.

Using fat for energy
After meals, the blood delivers chylomicrons and VLDL loaded with triglycerides to the body's cells for energy. Fat supplies about 60 per cent of the body's ongoing energy needs during rest. During prolonged light to moderately intense exercise or extended periods of food deprivation, fat may make a slightly greater contribution to energy needs. During energy deprivation, several lipase enzymes (particularly hormone-sensitive lipase) inside the adipose cells respond by dismantling stored triglycerides and releasing the glycerol and fatty acids directly into the blood. Energy-hungry cells anywhere in the body can then capture these compounds and take them through a series of chemical reactions to yield energy, carbon dioxide, and water. A person who fasts (drinking only water) will rapidly metabolise body fat. Even with abundant body fat, the person has to obtain some energy from lean protein tissue because the brain, nerves and red blood cells need glucose – and without carbohydrate, only protein and the small glycerol molecule of a triglyceride can be converted to glucose; fatty acids cannot be. Still, in times of severe hunger and starvation, a fatter person can survive longer than a thinner person thanks to this energy reserve. But as Chapter 7 explains, fasting for too long will eventually cause death, even if the person still has ample body fat.