The Human Digestive Tract

It is estimated that an adult consumes about 20,000 kg of food between the ages of 18 and 38 years; about a metric tonne a year. Although babies grow rapidly from birth, growth is not the most significant reason for our ongoing eating. Our bodies require a constant source of energy for the vast number of biochemical reactions that constitute metabolism. Food provides the source of this energy. Tube-like digestive tracts (guts) run through the body from the mouth to the anus. The digestive tract prepares the food we eat for use by the body's cells through five basic activities: eating (ingestion), movement (of food through the gut), digestion (physical and chemical breakdown), absorption, and elimination. However, the different specializations that occur in each region will depend both on the diet and the method of ingestion (prechewed, liquid, unchewed).

Structures of the Human Gut

Word list: Liver, small intestine, gall bladder, stomach, salivary glands, colon (large intestine), esophagus, pancreas, mouth and teeth, anus, rectum, appendix.

A  G  
B  H  
C  I  
D  J  
E  K  
F  L  

The Functions of Gut Structures

In the boxes provided, write the letter (A-L) that represents the part of the gut responsible for each of the functions summarized below:

(a) Main region for enzymatic digestion & nutrient absorption
(b) Consolidation of the feces before elimination
(c) Main function (humans) is water and mineral absorption
(d) Secretes acid and pepsin, stores and mixes food
(e) A gland which produces alkaline, enzyme-rich fluid
(f) Produces bile and has many homeostatic functions
(g) Produces saliva which contains the enzyme amylase
Human Heart Structure
(sectioned, anterior view)

Aorta carries oxygenated blood to the head and body
Vena cava receives deoxygenated blood from the head and body
Pulmonary artery carries deoxygenated blood to the lungs
Tricuspid valve prevents backflow of blood into right atrium
Chordae tendinae non-elastic strands supporting the valve flaps
Semi-lunar valve prevents the blood flow back into ventricle.

Key to abbreviations
RA Right atrium; receives deoxygenated blood via anterior and posterior vena cavae
RV Right ventricle; pumps deoxygenated blood to the lungs via the pulmonary artery
LA Left atrium; receives blood returning to the heart from the lungs via the pulmonary veins
LV Left ventricle; pumps oxygenated blood to the head and body via the aorta

1. Explain the purpose of the valves in the heart:

2. Discuss the structure of the heart in at least two vertebrates, relating features of the heart's structure and function to the animal's size, metabolic rate, or environment in each case:
Morphology of the Respiratory System

Nasal passages warm and moisten the air entering through the nostrils. Each nostril has a border of hairs to trap particles and filter them out of the system.

As entering the body through the mouth enters the pharynx and mixes with air from the nasal passages.

The trachea lies in front of the esophagus and extends into the thorax. It is strengthened with C-shaped bands of cartilage and lined with ciliated epithelium.

The trachea splits into two bronchi. These are also supported by cartilage bands.

Bronchioles branch off the bronchi and divide into progressively smaller branches. The cartilage is gradually lost as the bronchioles decrease in diameter.

Photograph left: The nasal epithelium produces large amounts of mucus, seen here as droplets.

Photograph below: The epithelium of the trachea has many cilia. Mucus is produced from goblet cells.

Columnar, ciliated epithelium

Photograph above: The epithelial lining of the bronchioles is ciliated and lined with mucus-producing goblet cells.

Photograph right: Respiratory bronchiole and alveolar duct leading to alveoli. Note the thin alveolar walls.

The smallest respiratory bronchioles subdivide into the alveolar ducts from which arise the alveoli.

The walls of the smallest bronchioles lack cartilage but have a large amount of smooth muscle.

The alveolar ducts lead to the alveoli. The alveoli tend to recoil inward (deflate) after each breath out. A phospholipid surfactant helps prevent this by decreasing surface tension in the lung.

Related activities: Gas Transport in Humans
Web links: Review of Lung Function
1. (a) Explain how the basic structure of the human respiratory system provides such a large area for gas exchange:


(b) Identify the general region of the lung where exchange of gases takes place:


2. Describe the structure and purpose of the respiratory membrane:


3. Describe the role of the surfactant in the alveoli:


4. Using the information above and on the previous page, complete the table below summarizing the histology of the respiratory pathway. Name each numbered region and use a tick or cross to indicate the presence or absence of particular tissues.

<table>
<thead>
<tr>
<th>Region</th>
<th>Cartilage</th>
<th>Ciliated epithelium</th>
<th>Goblet cells (mucus)</th>
<th>Smooth muscle</th>
<th>Connective tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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<td></td>
<td></td>
<td>✓</td>
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<td>4</td>
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<td></td>
<td></td>
<td>very little</td>
</tr>
</tbody>
</table>

5. Babies born prematurely are often deficient in surfactant. This causes respiratory distress syndrome; a condition where breathing is very difficult. From what you know about the role of surfactant, explain the symptoms of this syndrome:
Oogenesis

Oogenesis is the process by which mature ova (egg cells) are produced by the ovary. Oogonia are formed in the female embryo and undergo repeated mitotic divisions to form the primary oocyte. These remain in prophase of meiosis I throughout childhood. At this stage, all the eggs a female will ever have are present, but they remain in this resting phase until puberty. At puberty, meiosis resumes. Eggs are released, arrested in metaphase of meiosis II. This second division is only completed upon fertilization.

Fertilization occurs in the fallopian tube, after which it passes down to the uterus.

1. The female human reproductive system and associated structures are illustrated above. Using the word list, identify the labeled parts. **Word list:** ovary, uterus (womb), vagina, fallopian tube (oviduct), cervix, clitoris.

2. In a few words or a short sentence, state the function of each of the structures labeled (a) - (d) in the above diagram:

   (a) 
   (b) 
   (c) 
   (d) 

3. (a) Name the organ labeled (A) in the diagram:

   (b) Name the event associated with this organ that occurs every month:

   (c) Name the process by which mature ova are produced:

4. (a) Name the stage in meiosis at which the oocyte is released from the ovary:

   (b) State when in the reproductive process meiosis II is completed:

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Activity links: The Menstrual Cycle
The reproductive role of the male is to produce the sperm and deliver them to the female. When a sperm combines with an egg, it contributes half the genetic material of the offspring and, in humans and other mammals, determines its sex. The reproductive structures in human males (shown below) are in many ways typical of other mammals.

**Cross Section Through Seminiferous Tubule**

The photograph (below, left) shows maturing sperm (arrowed) with tails projecting into the tubule. Their heads are embedded in the Sertoli cells in the tubule wall and they are ready to break free and move to the epididymis where they complete their maturation. The same cross-section is illustrated diagrammatically (below, right).

**Spermatogenesis**

Spermatogenesis is the process by which mature spermatozoa (sperm) are produced in the testis. In humans, they are produced at the rate of about 120 million per day. Spermatogenesis is regulated by the hormones FSH (from the anterior pituitary) and testosterone (secreted from the testes in response to LH from the anterior pituitary). Spermatogonia, in the outer layer of the seminiferous tubules, multiply throughout reproductive life. Some of them divide by meiosis into spermatocytes, which produce spermatids. These are transformed into mature sperm by the process of spermiogenesis in the seminiferous tubules of the tests. Full sperm motility is achieved in the epididymis.