

Self-Assessment in Histology

QUESTIONS AND QUIZ MICROGRAPHS

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Preface

This book is not only intended for use by students revising for histology examinations, but also as an adjunct to the study of histology in general.

In principle, the most appropriate means of testing students' knowledge of histology is to use previously unseen quiz slides or photomicrographs. In practice this is usually economically prohibitive in a book of this type. We have however, been able to include a selection of thirty self assessment colour micrographs derived from material already published in our book *Functional Histology — a text and colour atlas* (Wheater P R, Burkitt H G, Daniels V G 1979 *Functional Histology — a text and colour atlas*. Churchill Livingstone, Edinburgh).

Since objective tests of the multiple choice or true/false format are being used increasingly for formal assessment, we have adopted this general approach in the preparation of the 800 questions. In keeping with our philosophy of teaching histology, the questions include relevant functional aspects of tissue structure. The questions have been designed not merely to assess but also to instruct and for this reason the usual strict examination format has not been slavishly followed and full explanations have been given in answer to all false statements.

It is hoped that this book will be useful for students using any histology textbook recommended by their teachers, nevertheless cross-references to *Functional Histology* have been given in brackets, e.g. (F.H. Fig 12.12) for topics we feel may pose particular problems to students. For the same reason, the order of questions closely follows the order of presentation of the chapter subject matter in *Functional Histology*.

Questions have been grouped in blocks of five referring to a single or related topics and it is suggested that students attempt all five questions of each block before referring to the answers. For ease of use, answers to questions are found immediately over the page rather than at the end of the section.

Finally, we express our gratitude to Mrs Christine Stevens for her meticulous typing of the manuscript.

Nottingham, 1980

Paul R. Wheeler
H. George Burkitt

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Part A

True/false questions and answers

- Q0 The fluid mosaic model of the plasma membrane is based on the plasma membrane being composed of a phospholipid bilayer decorated by a layer of proteins.
- Q1 In general, hydrophilic (lipophilic) molecules are able to diffuse freely across membranes.
- Q2 The plasma membrane is made up of phospholipids and some proteins.
- Q3 The membrane appearance of the plasma membrane often viewed with electron microscopy is explained in terms of the 'fluid mosaic' model of membrane structure.
- Q4 The plasma membrane is highly impermeable to small molecules.
- Q5 Lipid-soluble molecules such as steroid hormones pass through the plasma membrane by the process described as 'facilitated diffusion'.
- Q6 The 'sodium pump' is an example of an active transport mechanism that is effective against a concentration gradient.
- Q7 Most of the membrane transport processes are mediated by integral proteins.
- Q8 Pumps move the water across a membrane.

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Part A

True false questions and answers

Part A. True/false questions and answers

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1. The cell

- Q1** The 'fluid mosaic' model of membrane structure proposes that the plasma membrane consists of a bilayer of phospholipid molecules separated by a layer of protein.
- Q2** In general, hydrophobic (lipophilic) molecules are able to diffuse freely across membranes.
- Q3** The cholesterol molecules which are associated with plasma membranes form the so-called glycocalyx of some eukaryotic cells.
- Q4** The trilaminate appearance of the plasma membrane when viewed with electron microscopy is explicable in terms of the 'fluid mosaic' model of membrane structure.
- Q5** Large molecular-weight polysaccharide molecules form 'dynamic pores' for transport of molecules such as sodium ions into cells.
- Q6** Lipid-soluble molecules such as ethanol cross membranes by the process described as 'facilitated diffusion'.
- Q7** 'Facilitated diffusion' permits the transport of molecules across membranes against a concentration gradient.
- Q8** The 'sodium pump' is an example of an active transport mechanism since it is effective against a concentration gradient.
- Q9** Only active membrane transport processes are enhanced by increasing the plasma membrane surface area.
- Q10** Phagocytosis is the reverse process of endocytosis.

Answers

- A1 F** The 'fluid mosaic' model proposes that the plasma membrane consists of two layers of phospholipid molecules; globular proteins 'float' at various levels in the membrane, some exposed to inner or outer environments, others spanning the whole thickness of the membrane. All membrane constituents may move laterally (i.e. they are fluid) in the membrane.
- A2 T**
- A3 F** Cholesterol molecules are located amongst the hydrophobic 'tails' of the phospholipid molecules in the middle of the membrane; the glycocalyx is composed of glycoproteins and glycolipids.
- A4 T** [F.H. p. 5].
- A5 F** The 'dynamic pores' consist of proteins (enzyme systems) incorporated in the plasma membrane.
- A6 F** Lipid-soluble molecules diffuse passively through the lipid component of membranes.
- A7 F** Facilitated diffusion only operates along a favourable concentration gradient but differs from passive diffusion by permitting passage of certain small molecules such as glucose which are not lipid soluble.
- A8 T***
- A9 F** All membrane transport processes are enhanced by increased surface area.
- A10 F** Phagocytosis is a form of endocytosis involving engulfment of particulate matter; when fluid matter is involved, endocytosis is often referred to as pinocytosis.

- Q11** Primary lysosomes are electron-lucent structures bounded by a membrane.
- Q12** Phagosomes are also referred to as lipofuscin granules.
- Q13** Autophagy is one of the processes involved in the continuous turnover of cytoplasmic organelles.
- Q14** Multivesicular bodies are a storage form of lysosomal precursors.
- Q15** Alkaline phosphatase activity is a useful histochemical marker for lysosomes.
- Q16** Cellular enzymes are subject to wear and tear and are continuously turned over, whereas structural proteins in the cell are completely stable.
- Q17** Messenger RNA synthesis involves transcription of part of the genome.
- Q18** Ribosomal RNA is synthesised in the nucleus.
- Q19** Each ribosome consists of two subunits, one of which is composed of RNA and the other composed of ribosomal proteins.
- Q20** Unlike messenger and ribosomal RNA, transfer RNA is synthesised by ribosomes.

Answers

- A11 F** Primary lysosomes are electron-dense structures (i.e. dark grey to black).
- A12 F** Phagosomes are vesicles containing engulfed material; lipofuscin granules are a brown-coloured form of residual bodies which accumulate in some tissues with increasing age or in certain pathological states. [F.H. Fig. 1.3].
- A13 T**
- A14 F** Multivesicular bodies are thought to be an unusual form of residual body.
- A15 F** Acid phosphatase is a characteristic histochemical marker for lysosomes.
- A16 F** All cellular proteins are turned over although at highly variable rates; structural proteins are, in general, turned over less rapidly than enzymes.
- A17 T**
- A18 T**
- A19 F** Both ribosomal subunits contain RNA and protein.
- A20 F** All RNA species are synthesised on a DNA template in the nucleus.

- Q21** A cell without a nucleus could not be involved in protein synthesis.
- Q22** The principal nuclear constituents are DNA, RNA and protein.
- Q23** Heterochromatin represents that part of the genome which is actively involved in RNA synthesis.
- Q24** Barr bodies represent a form of heterochromatin in the nuclei of cells from normal females.
- Q25** A prominent nucleolus is usually indicative of a high degree of cellular metabolic activity.
- Q26** The nucleus is bounded by two layers of membrane separated by a narrow space.
- Q27** Radio-isotope labelling studies have shown that nucleoli pass from the nucleus to the cytoplasm via pores in the nuclear envelope.
- Q28** The diameter of nuclear pores is about the same as that of mitochondria.
- Q29** Ribosomes are often attached to the surface of endoplasmic reticulum but may also lie free in the cytoplasm.
- Q30** Extensive rough endoplasmic reticulum is usually found in cells highly active in protein synthesis whereas extensive smooth endoplasmic reticulum is characteristic of cells highly active in lipid synthesis.

Answers

- A21 F** A non-nucleate cell could be involved in protein synthesis provided appropriate messenger, ribosomal and transfer RNA molecules were still present in the cytoplasm; e.g. in this way haemoglobin synthesis still continues in reticulocytes after extrusion of the nucleus during erythrocyte development.
- A22 T**
- A23 F** Heterochromatin represents that part of the genome relatively uninvolved in RNA synthesis (and thus protein synthesis); e.g. relatively inactive lymphocytes have a condensed nucleus mainly composed of heterochromatin.
- A24 T**
- A25 T**
- A26 T**
- A27 F** Nucleoli represent chromosome sites particularly active in RNA synthesis; chromosomes do not pass out of the nucleus.
- A28 F** Nuclear pores are very much smaller in diameter than mitochondria. [F.H. Figs. 1.7, 1.8].
- A29 T**
- A30 T**

- Q31** Exocytosis is the usual means of secretion of proteins and other lipid-soluble materials.
- Q32** The Golgi apparatus is a specialised area of rough endoplasmic reticulum involved in glycolipid synthesis.
- Q33** The Golgi apparatus is responsible for packaging large molecular weight secretory products prior to their secretion by exocytosis.
- Q34** Secretory products pass from the endoplasmic reticulum to the Golgi apparatus in the form of lysosomes.
- Q35** The Golgi apparatus is characteristically located immediately beneath the plasma membrane.
- Q36** Cellular respiration occurs in the cytosol, mitochondria and ribosomes.
- Q37** Eukaryotic cells without mitochondria are incapable of aerobic metabolism.
- Q38** The enzymes of the tricarboxylic acid cycle constitute the 'respiratory assemblies' and are located on the mitochondrial cristae.
- Q39** Mitochondria are capable of protein synthesis.
- Q40** Glycogen is characteristically stored within mitochondria where it forms so-called matrix granules.

Answers

- A31 F** Proteins are not lipid-soluble and are secreted by exocytosis; lipids diffuse out through the lipid component of the membrane.
- A32 F** The Golgi apparatus is a membranous organelle discrete from the rough endoplasmic reticulum; it is involved in packaging of proteinaceous or polypeptide secretory products prior to secretion, and the addition of the carbohydrate component in the case of glycoprotein or proteoglycan secretory products.
- A33 T**
- A34 F** Secretory products pass from the endoplasmic reticulum to the Golgi apparatus in vesicles known as transitional vesicles.
- A35 F** The Golgi apparatus usually lies deep in the cell adjacent to the nucleus.
- A36 F** Ribosomes are not a site of cellular respiration.
- A37 T**
- A38 F** Cytochromes are believed to be arranged as 'respiratory assemblies'; Krebs cycle enzymes are located in the mitochondrial matrix.
- A39 T** [F.H. Fig. 1.14].
- A40 F** Glycogen is stored in the cytosol; there is no evidence that mitochondrial matrix granules contain glycogen.

- Q41** All cellular movement is principally mediated by rearrangement of the protein subunits of the glycocalyx.
- Q42** Microfilaments consist of minute protein strands smaller in diameter than glycogen granules.
- Q43** Microtubules are thought to constitute a specialisation of the endoplasmic reticulum.
- Q44** Microtubules are of approximately the same diameter as microfilaments.
- Q45** With electron microscopy, microtubules can be distinguished from microfilaments by their extensive branching.
- Q46** Normal mitosis results in the production of two daughter cells which are genetically identical but which may not have identical cytoplasmic constituents.
- Q47** In the cell cycle, the G_1 phase is the same as interphase.
- Q48** After replication of the genome, the cell immediately enters mitosis.
- Q49** A cell which is in the G_0 phase of the cell cycle may re-enter the cell cycle under appropriate circumstances.
- Q50** Since the process of mitosis usually takes many days to complete, mitotic figures are observable in very large numbers in tissues made up of rapidly dividing cells.

Answers

- A41 F** The principal organelles involved in cell movement are microtubules and microfilaments.
- A42 T**
- A43 F** Microtubules are made up of globular proteins, not membranes. [F.H. Fig. 1.16].
- A44 F** Microtubules are of much greater diameter than microfilaments.
- A45 F** Microtubules are unbranched structures, much larger in diameter than microfibrils.
- A46 T**
- A47 F** The G_1 , S and G_2 phases together make up interphase.
- A48 F** After the S phase, during which the DNA (the genome) is duplicated, there is an interval known as the G_2 phase before mitosis commences.
- A49 T**
- A50 F** Mitosis takes only about 30 to 60 minutes in mammalian cells and thus comprises only a short portion of the total cell cycle duration; even in tissues made up of rapidly dividing cells, mitotic figures are relatively few and far between.