

Contents

Introduction

ix

I

CELLS

A. The Animal Cell

3

Introductory Study

3

Study of Cellular Structure With the Light Microscope

4

Study of Cellular Structure With the Electron Microscope

12

Freeze Fracture

24

B. Cell Division

27

Mitosis

27

Colchicine, Mitosis, and Karyotypes

36

Duration of the Mitotic Cycle

40

Amitosis

40

Meiosis

40

II

TISSUES

C. Epithelial Tissues

45

Classification of Epithelia

45

Endothelium and Mesothelium

52

Intercellular Specializations of Epithelia

60

Glandular Epithelia

65

Holocrine, Merocrine, and Apocrine Glands

71

D. Connective Tissues

75

Embryonic Connective Tissue

75

Components of Adult Connective Tissues

75

Loose Connective Tissues

93

Dense Connective Tissues

96

E. Muscle

119

Smooth Muscle

119

Striated or Skeletal Muscle

120

Cardiac Muscle

130

F. Nervous Tissue

141

The Neuron

141

Nonnervous Components of Nervous Tissue

159

G. Blood and Lymph

171

Blood

171

Lymph

190

Hemopoiesis

190

Hemopoiesis in Lymphoid Tissue

200

III

ORGANS AND ORGAN SYSTEMS

H. The Circulatory System

205

Fundamental Plan of the Vascular System

205

Arteries

207

The Microcirculation

210

Veins

220

Comparisons

221

I. Hemopoietic Organs

227

Hemopoietic Organs in the Lower Vertebrates

227

Hemopoietic Organs of Higher Vertebrates

227

Lymphoid Organs of Higher Vertebrates

228

Myeloid Organs: The Bone Marrow

256

J. Integument

257

Skin

257

Other Integumentary Glands

269

Digital Tips	287	Opisthonephros	437
Horns and Antlers	288	Metanephros	447
		Ultrastructural Aspects of Urine Production	452
K. The Digestive System	291	Comparative Histology of the Metanephros	455
General Arrangement of the Digestive Tube	291	Juxtaglomerular Complex and the Control of	
Oral Cavity	294	Blood Pressure	458
Esophagus	313	Ureter of Amniotes	461
Junction of Stomach and Esophagus	316	Urinary Bladder	463
Stomach	317	Mammalian Urethra	465
Gastroduodenal Junction	330	Extrarenal Excretion of Salt	466
Small Intestine	332		
Comparative Histology of the Small Intestine	343	N. Endocrine Organs	479
Ileocecal Valve	347	Pituitary Gland or Hypophysis	479
Large Intestine	349	The Caudal Neurosecretory System and Urophysis	
Colon	351	of Fishes	485
Rectum	354	Pineal Body or Epiphysis Cerebri	486
Cecum	355	Thyroid Gland	491
Vermiform Appendix	356	Parathyroid Glands	497
Comparative Histology of the Large Intestine	357	Ultimobranchial Bodies	501
Glands Associated With the Digestive Tract	358	Adrenal Glands	502
Comparative Histology of the Salivary Glands	363		
Pancreas	363	O. Genital Systems	511
Comparative Histology of the Pancreas	365	Female	511
Liver	367	Male	535
Comparative Histology of the Liver	375		
Gall Bladder	377	P. Sense Organs	553
		Eye	553
L. Respiratory Systems	389	Lateral Line Organs	573
Water Breathing	389	Ear	573
Air Breathing	394		
Vomeronasal Organ	400		
Lungs and Air Ducts	402		
Swim Bladder	422		
		Image and Diagram Acknowledgments	579
M. Excretory Systems	427	Index	591
Evolution of the Kidney	427		
Pronephros or Head Kidney	429		