

CONTENTS

Contributors

xi

Preface

xiii

1. The Physical and Biochemical Properties of the Extracellular Matrix Regulate Cell Fate

1

Jonathon M. Muncie and Valerie M. Weaver

- | | |
|---|----|
| 1. Introduction | 2 |
| 2. ECM Composition | 4 |
| 3. ECM Regulates Development and Modulates Stem Cell Fate | 8 |
| 4. Cell-ECM Signaling | 10 |
| 5. ECM-Dependent Modulation of Growth Factor and Morphogen Function | 13 |
| 6. ECM-Dependent Spatial-Mechanical Regulation of Cell Phenotype | 15 |
| 7. Summary and Future Directions | 21 |
| Acknowledgments | 24 |
| References | 24 |

2. Matricellular Proteins: Functional Insights From Non-mammalian Animal Models

39

Josephine C. Adams

- | | |
|--|----|
| 1. General Introduction | 40 |
| 2. An Introduction to Matricellular Proteins | 47 |
| 3. Matricellular Proteins in Early Diverging Metazoans and Protostomes | 60 |
| 4. Matricellular Proteins in Invertebrate Deuterostomes | 72 |
| 5. Matricellular Proteins in Cyclostoma (Jawless Vertebrates) | 73 |
| 6. Matricellular Proteins in Nonmammalian Vertebrate Model Animals | 73 |
| 7. Perspectives | 85 |
| Acknowledgments | 88 |
| References | 88 |

3. Collagen Fibril Assembly and Function

107

David F. Holmes, Yinhui Lu, Tobias Starborg, and Karl E. Kadler

- | | |
|--|-----|
| 1. Introduction | 108 |
| 2. Fibril Structural Hierarchy—From Molecules to Fibril Arrays | 110 |
| 3. Collagen Fibril Formation as a Self-Assembly Process | 115 |
| 4. Collagen Fibril Growth Regulation Models | 120 |

5. Collagen Fibril Formation In Vivo: Extrinsic Control of Fibril Formation	125
6. Collagen Fibril Structure	129
7. Future Directions	134
Acknowledgments	135
References	135
4. Basement Membranes in Development and Disease	143
Rei Sekiguchi and Kenneth M. Yamada	
1. Introduction	144
2. Functions	145
3. Composition	153
4. Spatial and Temporal Variations in Basement Membrane Thickness and Composition	160
5. Basement Membrane Microperforations	169
6. Basement Membrane Transmigration and Invasion	172
7. Perspectives and Future Directions	177
Acknowledgments	179
References	179
5. Extracellular Determinants of Arterial Morphogenesis, Growth, and Homeostasis	193
Robert P. Mecham and Francesco Ramirez	
1. Introduction	194
2. Evolution of the Cardiovascular System	196
3. ECM Composition and Mechanical Signaling During Arterial Development	202
4. ECM and Arterial Tissue Organization and Function	207
5. Concluding Remarks	212
References	212
6. Structure, Function, and Development of the Tectorial Membrane: An Extracellular Matrix Essential for Hearing	217
Richard J. Goodyear and Guy P. Richardson	
1. Introduction	218
2. The Cochlea and the Mammalian TM	219
3. Proteins of the Mammalian TM	220
4. Structure/Ultrastructure of the Mammalian TM	223
5. Function of the Mammalian TM	227
6. Avian Basilar Papilla and TM	228
7. Proteins of the Avian TM	230

8. Structure and Attachment of the Avian TM	230
9. Function of the Avian TM	230
10. Chick TM Development	231
11. Mammalian TM Development	232
12. Collagen Fibrils: Orientation and Alignment	233
13. Hensen's Stripe and the Minor TM	235
14. Marginal Pillars	236
15. Crowns, Imprints, STRC, and Hair-Bundle Attachment	237
16. Striated-Sheet Matrix	237
17. Evolution of the TM	238
Acknowledgments	239
References	239
7. Extracellular Matrix (ECM) and the Sculpting of Embryonic Tissues	245
Bette J. Dzamba and Douglas W. DeSimone	
1. Introduction	246
2. The Role of ECM in Resisting and Constraining Tissues	250
3. Coordination and Coupling of Forces Across and Between Tissues	256
4. Subdivision of Tissues by ECM	262
Acknowledgments	268
References	268
8. The Fish Egg's Zona Pellucida	275
Eveline S. Litscher and Paul M. Wassarman	
1. Introduction to the Fish Egg's Zona Pellucida	276
2. Hagfish and Lamprey Eggs	279
3. Cartilaginous Fish Eggs	282
4. "Modern" Fish Eggs	286
5. Sturgeon Eggs	288
6. Rainbow Trout Zona Pellucida Proteins	289
7. Postfertilization Changes in the Zona Pellucida	295
8. Antifreeze Protection by Zona Pellucida Proteins	296
9. Zona Pellucida Fibrils and Desiccation	297
10. ZP1 and Amyloid Fibrils	299
11. ZP1 Amino-Terminal Domains	300
Acknowledgments	302
References	302

9. Egg-Coat and Zona Pellucida Proteins of Chicken as a Typical Species of Aves	307
Shunsuke Nishio, Hiroki Okumura, and Tsukasa Matsuda	
1. Egg Development and the Egg-Coat of Birds	308
2. Structure of Chicken Egg-Coat and the Constituting ZP Proteins	310
3. The Crystal Structure of ZP3 Homodimer and Furin Cleavage-Induced Dimerization	314
4. Expression of ZP Genes at Developmental Stages of Growing Oocyte	316
5. Secretion, Transport, and Assembly for Matrix Formation Around the Oocyte	318
6. Interaction of Egg-Coat With Sperm at Fertilization	319
7. Lytic Degradation of the Egg-Coat and ZP Protein Fragmentation During Sperm Penetration	322
8. The Robust and Elastomeric Egg-Coat for Birds' Eggs With Mass of Egg Yolk	324
References	326
10. The Mouse Egg's Zona Pellucida	331
Paul M. Wassarman and Eveline S. Litscher	
1. Introduction to the Zona Pellucida	332
2. Oogenesis in Mice	333
3. Zona Pellucida Proteins	336
4. Zona Pellucida Domain Proteins	338
5. Zona Pellucida Protein Synthesis	340
6. Zona Pellucida-Knockout Mice	343
7. Zona Pellucida Protein Secretion and Assembly	345
8. Zona Pellucida and Fertilization	347
9. Summary	350
Acknowledgments	350
References	350
11. Conceptus Coats of Marsupials and Monotremes	357
Stephen Frankenberg and Marilyn B. Renfree	
1. Introduction	358
2. Preovulatory Coats	361
3. Postovulatory Coats	364
4. Summary and Conclusions	374
References	374

12. The Human Egg's Zona Pellucida	379
Satish K. Gupta	
1. Structure of Human Zona Pellucida	380
2. Biochemical Characteristics of the Human ZP Matrix	381
3. Genomic Organization and Amino Acid Sequence of the Human ZP Glycoproteins	382
4. Expression of ZP Glycoproteins in Human Ovaries	387
5. Role of Human ZP Glycoproteins in Sperm Binding and Induction of Acrosome Reaction	388
6. Relevance of Glycosylation of Human Zona Proteins in Fertilization	396
7. Signaling Events Associated With Human ZP Glycoproteins-Mediated Acrosome Reaction	398
8. Relevance of ZP Matrix in Avoidance of Polyspermy During Fertilization	402
9. ZP Defects and Female Factor Infertility: Clinical Significance	403
10. Significance of ZP Autoantibodies in Women With "Unexplained Infertility"	404
11. Conclusions	405
Acknowledgments	405
References	405
13. Structure of Zona Pellucida Module Proteins	413
Marcel Bokhove and Luca Jovine	
1. Introduction: The ZP "Domain" Module	414
2. Structures of The ZP-N Domain	417
3. Structures of the ZP-C Domain	423
4. ZP-N and ZP-C Compared to Ig-Like Domains	427
5. Structures of Complete ZP Modules: Insights Into Polymerization	430
6. How Life Begins: Egg ZP-N Domain Recognition by Sperm	433
7. Concluding Remarks and Future Directions	436
Acknowledgments	438
References	438
14. Egg Coat Proteins Across Metazoan Evolution	443
Emily E. Killingbeck and Willie J. Swanson	
1. Introduction	444
2. Egg Coat Proteins	445
3. The ZP Module	450
4. Synthesis and Polymerization of ZP Proteins	453
5. Egg Coat Structure	456

6. ZP Proteins in Fertilization	466
7. Evolution of Egg Coat Proteins	469
8. Final Comments	474
Acknowledgments	475
References	475