



# CONTENTS

DEDICATION V

CONTRIBUTORS VII

PREFACE XVII

## SECTION I INTRODUCTION OF CANCER BIOLOGY AND CANCER GENETICS 1

---

**CHAPTER 1**  
CELL PROLIFERATION AND APOPTOSIS 2  
Laura B. Pitzonka and David W. Goodrich

**CHAPTER 2**  
CANCER STEM CELLS 14  
Sadhna Dhingra and Dongfeng Tan

**CHAPTER 3**  
CELL SIGNAL TRANSDUCTION 29  
Markus Morkel

**CHAPTER 4**  
ONCOGENES 41  
Sadhna Dhingra and Dongfeng Tan

**CHAPTER 5**  
TUMOR SUPPRESSOR GENES 47  
Markus Reschke, Lev M. Kats, and Pier Paolo Pandolfi

**CHAPTER 6**  
VIRUSES AND HUMAN CANCERS: PATHOGENESIS  
AND THERAPEUTIC IMPLICATION 56  
Ih-Jen Su, Yao Chang, Grace Yu, and  
Charles Dwo-Yuan Sia

## SECTION II MOLECULAR TECHNIQUES 69

---

**CHAPTER 7**  
INTRODUCTION TO MOLECULAR TECHNIQUES  
AND INSTRUMENTATION 70  
Shengle Zhang and Dongfeng Tan

**CHAPTER 8**  
TRANSCRIPTOME ANALYSIS 86  
Shengle Zhang

**CHAPTER 9**  
IMMUNOHISTOCHEMISTRY 96  
Jeannelyn S. Estrella

**CHAPTER 10**  
CANCER GENOMIC SEQUENCING 103  
Yingfei Wei and Guo-Liang Yu

**CHAPTER 11**  
MASS SPECTROMETRY: PRINCIPLES  
AND APPLICATIONS IN CANCER  
DIAGNOSIS AND MANAGEMENT 112  
Oliver J. Semmes, Richard R. Drake, and  
Julius O. Nyalwidhe

**CHAPTER 12**  
CANCER PROTEOMICS 126  
Kristin Huntoon and Zhengping Zhuang

**CHAPTER 13**  
MORPHOPROTEOMICS 133  
Robert E. Brown and Jamie J. Buryanek



**CHAPTER 14**  
FLOW CYTOMETRY 143  
*George Deeb*

**CHAPTER 15**  
CANCER CYTOGENOMICS 153  
*Gary Lu*

**CHAPTER 16**  
DNA HYPERMETHYLATION IN CANCER 180  
*Bin Yang*

**CHAPTER 17**  
SINGLE NUCLEOTIDE POLYMORPHISMS 186  
*Qingyi Wei*

**SECTION III**  
**MOLECULAR TESTS AND CANCER  
MANAGEMENT 195**

---

**CHAPTER 18**  
OVERVIEW OF MOLECULAR TESTS  
AND PERSONALIZED CANCER MEDICINE 196  
*Manuel Salto-Tellez*

**CHAPTER 19**  
MOLECULAR SCREENING, GENETIC  
COUNSELING, AND CANCER PREVENTION:  
LYNCH SYNDROME AS A MODEL 206  
*Henry T. Lynch, Carrie L. Snyder, Jane F. Lynch,  
Stephen Lanspa, and Peter Silberstein*

**CHAPTER 20**  
MOLECULAR IMAGING AND CANCER  
MANAGEMENT: PET AND MR AGENTS FOR  
MOLECULAR IMAGING OF CANCER  
METABOLISM 233  
*Yunkou Wu, Xiankai Sun, and A. Dean Sherry*

**CHAPTER 21**  
DETECTION AND MOLECULAR MONITORING  
OF MINIMAL RESIDUAL DISEASES IN MYELOID  
NEOPLASMS 247  
*C. Cameron Yin*

**CHAPTER 22**  
MOLECULAR ASSESSMENT OF CANCER  
PROGNOSIS 265  
*Qing Zhao and Dongfeng Tan*

**CHAPTER 23**  
QUALITY CONTROL, ASSURANCE,  
AND STANDARDIZATION OF MOLECULAR  
DIAGNOSTICS 278  
*Matthew J. McGinniss, Ryan P. Bender, and  
Anatole Ghazalpour*

**CHAPTER 24**  
BIostatISTICS AND BIOINFORMATICS 290  
*Qian Shi and Daniel J. Sargent*

**CHAPTER 25**  
IN VITRO COMPANION DIAGNOSTIC AND  
ANTI-CANCER DRUG CO-DEVELOPMENT:  
REGULATORY PERSPECTIVES 301  
*Reena Philip, Elizabeth Mansfield, Lea Carrington,  
Yun-Fu Hu, and Maria Chan*

**SECTION IV**  
**MOLECULAR DIAGNOSTICS OF COMMON  
MALIGNANCIES 307**

---

**CHAPTER 26**  
MOLECULAR BIOLOGY AND PATHOLOGY OF  
LUNG CANCER: GENOTYPE-MORPHOLOGY  
CORRELATION 308  
*Yuichi Ishikawa and Osamu Matsubara*

**CHAPTER 27**  
MOLECULAR DIAGNOSTICS OF  
BREAST CANCER 323  
*Ping Tang and David G. Hicks*

**CHAPTER 28**  
MOLECULAR DIAGNOSTICS OF COLORECTAL  
CANCER 339  
*Dongfeng Tan*

**CHAPTER 29**  
MOLECULAR DIAGNOSTICS OF ESOPHAGEAL  
AND GASTRIC CANCERS 356  
*Wataru Yasui, Naohide Oue, Kazuhiro Sentani,  
and Dongfeng Tan*



**CHAPTER 30**

MOLECULAR BIOLOGY OF PROSTATE CANCER:  
PRACTICAL CONSIDERATIONS FOR DIAGNOSIS  
AND PROGNOSIS 368

David G. Bostwick

**CHAPTER 31**

MOLECULAR DIAGNOSTICS OF  
HEPATOCELLULAR CARCINOMA 387

Seung Kew Yoon, Hyun Goo Woo, Dongfeng Tan,  
and Yoon Jun Kim

**CHAPTER 32**

MOLECULAR DIAGNOSTICS OF  
PANCREATIC CANCER 399

Marco Dal Molin and Anirban Maitra

**CHAPTER 33**

MOLECULAR DIAGNOSTICS OF HEAD  
AND NECK CANCER 417

Adel K. El-Naggar

**CHAPTER 34**

IMMUNOHISTOCHEMICAL AND MOLECULAR  
DIAGNOSIS OF MELANOMA 434

Andrea Suárez and Whitney A. High

**CHAPTER 35**

MOLECULAR DIAGNOSTICS OF HEMATOPOIETIC  
NEOPLASMS 451

Qiulu Pan and Dan Jones

**CHAPTER 36**

MOLECULAR DIAGNOSTICS OF  
LYMPHOMAS 465

Keila Rivera-Roman and Christopher D. Gocke

**CHAPTER 37**

MOLECULAR DIAGNOSTICS OF GYNECOLOGIC  
NEOPLASMS 477

Robert J. Kurman, Christina M. Bagby,  
and le-Ming Shih

**CHAPTER 38**

MOLECULAR DIAGNOSTICS OF BLADDER  
AND KIDNEY CANCERS 492

Hikmat A. Al-Ahmadie, Ying-Bei Chen,  
and Victor E. Reuter

**CHAPTER 39**

MOLECULAR DIAGNOSIS OF SOFT  
TISSUE SARCOMAS 506

Jorge Torres-Mora and Andre M. Oliveira

**CHAPTER 40**

MOLECULAR DIAGNOSIS OF GLIOMA 520

Adriana Olar and Gregory N. Fuller

**CHAPTER 41**

MOLECULAR DIAGNOSTICS OF  
PEDIATRIC NEOPLASMS 528

Jennifer Picarsic, Marina Nikiforova,  
and Miguel Reyes-Múgica

**CHAPTER 42**

MOLECULAR DIAGNOSTICS OF  
METASTATIC MALIGNANCIES 550

Mikhail Lisovsky, Laura J. Tafe, and Joel A. Lefferts

**SECTION V**

MOLECULAR BASIS OF CANCER  
THERAPEUTICS 565

**CHAPTER 43**

DNA REPAIR AND CANCER THERAPEUTICS 566

Mark R. Kelley and Melissa L. Fishel

**CHAPTER 44**

MONOCLONAL ANTIBODIES FOR  
THE TREATMENT OF CANCER 580

Jason C. Steel, Brian J. Morrison, and John C. Morris

**CHAPTER 45**

VACCINES AND CANCER THERAPY 594

Joseph W. Kim and James L. Gulley

**CHAPTER 46**

CANCER GENE THERAPY: NUCLEIC ACIDS AS  
THERAPEUTIC AGENTS 610

Richard A. Morgan and Daniel Abate-Daga

**CHAPTER 47**

ANTI-ANGIOGENESIS THERAPY OF CANCER 628

Kun Guo and Keping Xie



**CHAPTER 48**  
MICRORNAS AND CANCER THERAPEUTICS 637  
Maitri Y. Shah and George A. Calin

**CHAPTER 49**  
MOLECULAR BASIS OF CANCER RADIATION  
TREATMENT 646  
Heath Skinner, Amit Deorukhkar,  
and Sunil Krishnan

**CHAPTER 50**  
NANOTECHNOLOGY AND CANCER  
THERAPY 655  
Chun Li

**CHAPTER 51**  
NEW APPROACHES TO INTEGRATION OF  
PERSONALIZED MEDICINE IN EARLY CANCER  
DRUG DEVELOPMENT 659  
Aik-Choon Tan, Stephen Leong, Todd M. Pitts,  
John J. Tentler, and S. Gail Eckhardt

SECTION **VI**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF CANCER 675

---

**CHAPTER 52**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF LUNG CANCER 676  
Mary C. Pinder-Schenck and Scott J. Antonia

**CHAPTER 53**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF BREAST CANCER 692  
Komal Jhaveri, Chau Dang, and Clifford Hudis

**CHAPTER 54**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY FOR COLORECTAL CANCER 715  
Joleen M. Hubbard and Axel Grothey

**CHAPTER 55**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF ESOPHAGEAL CANCER 729  
Harry H. Yoon and Frank A. Sinicrope

**CHAPTER 56**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF GASTRIC CANCER 741  
YingWei Xue, XueFeng Yu, and Yanqiao Zhang

**CHAPTER 57**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY FOR PROSTATE CANCER 752  
Madhuri Bajaj, Michael A. Carducci,  
and Elisabeth I. Heath

**CHAPTER 58**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF HEPATOCELLULAR CARCINOMA 765  
Jiang Hongchi, John W. Linford,  
and Ahmed O. Kaseb

**CHAPTER 59**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF PANCREATIC CANCER: CURRENT  
STATUS AND PROPOSED STRATEGIES 780  
Milind Javle

**CHAPTER 60**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF NEUROENDOCRINE  
NEOPLASMS 790  
Jeana Garris and James C. Yao

**CHAPTER 61**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF HEAD AND NECK CANCER 797  
Ronald Myint, Kathryn A. Gold, and Edward S. Kim

**CHAPTER 62**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY FOR MELANOMA 805  
Keith T. Flaherty

**CHAPTER 63**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF LEUKEMIA 815  
Pavan Kumar Bhamidipati, Elias Jabbour,  
and Jorge Cortes

**CHAPTER 64**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF GYNECOLOGIC CANCERS 845  
Lainie P. Martin and Russell J. Schilder



**CHAPTER 65**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF RENAL CELL CARCINOMA 862  
C. Lance Cowey and Thomas E. Hutson

**CHAPTER 66**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY OF GLIOMAS 878  
Brett J. Theeler, John De Groot, and W.K. Alfred Yung

**CHAPTER 67**  
PERSONALIZED MEDICINE AND TARGETED  
THERAPY FOR OSTEOSARCOMA 900  
Jonathan Gill, David Geller, and Richard Gorlick

**CHAPTER 68**  
MOLECULAR BASIS OF CHEMORADIOTHERAPY  
AND HIGH-PRECISION RADIOTHERAPY 909  
Michio Yoshimura, Masahiro Hiraoka,  
and Hiroshi Harada

SECTION **VII**  
FUTURE OF MOLECULAR DIAGNOSTICS  
AND PERSONALIZED CANCER MEDICINE 923

---

**CHAPTER 69**  
NEW APPROACHES TO PERSONALIZED  
MEDICINE AND TARGETED DRUG  
DISCOVERY 924  
Garrett M. Dancik and Dan Theodorescu

**CHAPTER 70**  
THE FUTURE OF MOLECULAR DIAGNOSTICS  
IN ONCOLOGY 936  
Michael C. Dugan and Dongfeng Tan

INDEX 944