

Contents

<i>Preface</i>	<i>page xi</i>
1 Setting the Stage: Star Formation and Hydrogen Burning in Single Stars	
1. Introduction	1
2. Background	2
3. Evolution	16
2 Stellar Death: The Inexorable Grip of Gravity	
1. Red Giants	27
2. Stellar Winds	32
3. Quantum Deregulation	36
4. Core Collapse	38
5. Transfiguration	40
3 Dancing with Stars: Binary Stellar Evolution	
1. Multiple Stars	43
2. Stellar Orbits	44
3. Roche Lobes: The Cult Symbol	46
4. The First Stage of Binary Evolution: The Algol Paradox	48
5. Mass Transfer	49

6. Large Separation	51
7. Small Separation	52
8. Evolution of the Second Star	53
9. Common-Envelope Phase	53
10. Gravitational Radiation	55
4 Accretion Disks: Flat Stars	
1. Background Perspective	57
2. How a Disk Forms	58
3. Let There Be Light – and X-Rays	60
4. A Source of Friction	61
5. A Life of Its Own	63
6. Not So Flat, Buddy!	67
5 White Dwarfs: Quantum Dots	
1. Single White Dwarfs	69
2. Cataclysmic Variables	70
3. The Origin of Cataclysmic Variables	73
4. The Final Evolution of Cataclysmic Variables	76
6 Supernovae: Stellar Catastrophes	
1. Observations	80
2. The Fate of Massive Stars	85
3. Element Factories	87
4. Collapse and Explosion	88
5. Type Ia Supernovae: The Peculiar Breed	94
6. Light Curves: Radioactive Nickel	101
7 Supernova 1987A: Lessons and Enigmas	
1. The Large Magellanic Cloud Awakes	108
2. The Onset	110
3. Lessons from the Progenitor	118
4. Neutrinos!	121
5. Neutron Star?	123
6. The Light Curve	124
7. This Cow's Not Spherical	124
8. Other Firsts	125
9. Rings and Things	126
8 Neutron Stars: Atoms with Attitude	
1. History – Theory Leads, for Once	130

2. The Nature of Pulsars – Not Little Green Men	132
3. Pulsars and Supernovae – A Game of Hide and Seek	136
4. Neutron Star Structure – Iron Skin and Superfluid Guts	138
5. Binary Pulsars – Tango por Dos	142
6. X-Rays from Neutron Stars – Hints of a Violent Universe	145
7. X-Ray Flares – A Story Retold	151
8. The Rapid Burster – None of the Above	154
9. Millisecond Pulsars	156
10. Soft Gamma-Ray Repeaters – Reach Out and Touch Someone	159
11. Geminga	163
9 Black Holes in Theory: Into the Abyss	
1. Why Black Holes?	165
2. The Event Horizon	168
3. Singularity	169
4. Being a Treatise on the General Nature of Death Within a Black Hole	171
5. Black Holes in Space and Time	173
6. Black Hole Evaporation: Hawking Radiation	185
7. Fundamental Properties of Black Holes	188
8. Inside Black Holes	189
10 Black Holes in Fact: Exploring the Reality	
1. The Search for Black Holes	196
2. Cygnus X-1	198
3. Other Suspects	201
4. Black Hole X-Ray Novae	202
5. The Nature of the Outburst	204
6. Lessons from the X-Rays	206
7. SS 433	209
8. Miniquasars	211
11 Supernovae, Gamma-Ray Bursts, and the Universe: Long, Long Ago and Far, Far Away	
1. Probing the Size, Shape, and Fate of the Universe with Supernovae	213
2. Gamma-Ray Bursts	231

12	Black Holes, Worm Holes, and Beyond: The Frontiers	
	1. Worm Holes	255
	2. Time Machines	261
	3. Quantum Gravity	265
	4. String Theory	268
	5. When the Singularity Is Not a Singularity	274
	<i>Index</i>	281