

Photo Credits

iv (top right), © Wally Eberhart/Visuals Unlimited, Inc.; v (top right), © Daryl Benson/Masterfile; v (bottom right), Artbase Inc.; vi (centre left), © Leonard Rue III/Visuals Unlimited, Inc.; vii (top right), © 1997 Brownie Harris/The Stock Market/Firstlight.ca; xii (top left), Paul McCormick/Image Bank; xii (centre right), Artbase Inc.; xii (center left), Minnesota Historical Society/CORBIS/MAGMA; xii (bottom right), Malcolm Hanes/Bruce Coleman Inc.; xiii (top left), Artbase Inc.; xiii (centre right), Jose L. Pelaez/The Stock Market/Firstlight.ca; 4 (bottom right), Stephen Saks/Photo Researchers Inc.; 9 (top right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 9 (centre right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 13 (top), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; 2-3 (centre), Paul McCormick/Image Bank; 35 (bottom right), Artbase Inc.; 37 (bottom centre), Dick Keen/Visuals Unlimited; 37 (centre right), Paul Eekhoff/Masterfile; 39 (top right), © Wally Eberhart/Visuals Unlimited; 46 (centre left), Artbase Inc.; 56 (bottom centre), Visuals Unlimited; 57 (centre left), Artbase Inc.; 65 (centre), © E.R. Degginger/Color-Pic, Inc.; 68 (centre left), © Chris Sorensen; 69 (top left), Blue-Zone Technologies; 82 (top centre), Lynn Goldsmith/CORBIS/MAGMA; 82 (top right), Jacqui Hurst/CORBIS/MAGMA; 89 (top right), Herb Segars/Animals Animals; 91 (top left), © Gunther/Explorer/Photo Researchers Inc.; 91 (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 92 (top centre), Photo Courtesy Vince Satira; 92 (top right), © Science Pictures Ltd/Science Photo Library/Photo Researchers Inc.; 92 (centre), Artbase Inc.; 92 (centre right), © Studio/Science Photo Library/Photo Researchers Inc.; 94 (top left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 97 (top centre), © Jerome Wexler/Visuals Unlimited; 110 (top right), Photo Researchers Inc.; 116-117 (centre), Artbase Inc.; 118 (bottom left), © Daryl Benson/Masterfile; 119 (bottom right), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; 121 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 123 (top right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 123 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 123 (centre right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 123 (bottom), © John Talbot; 125 (bottom), © John Talbot; 128 (top), From Chemistry 11, © 2001 McGraw-Hill Ryerson Limited, a subsidiary of The McGraw-Hill Companies; 128 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 129 (centre left), Lawrence Berkeley National Laboratory/PhotoDisc; 131 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 132 (top left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 133 (centre), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; 137 (bottom), From Physics 12, © 2002, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; 145 (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 148 (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 148 (centre left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 152 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 154 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 155 (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 155 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 155 (bottom right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 156 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 167 (top right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 168 (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 169 (top), Stephen Frisch; 169 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 170 (top left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 170 (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 172 (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 179 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 186 (bottom left), Photo Courtesy of Dr. Richard Bader; 186 (centre left), Photo Courtesy of Dr. Richard Bader; 190 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 191 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 192 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 193 (centre left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 193 (centre right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 194 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 195 (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 197 (bottom left), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; 197 (bottom centre), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; 197 (bottom right), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; 199 (top right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; 199 (centre right), © Rosalind Franklin/Science Photo Library/Photo Researchers Inc.; 199 (bottom right), Hulton Archive/STONE; 200 (top right), Photo courtesy the Photo Imaging Department at the University of Waterloo;

206 (bottom right), AT&T Bell Labs/Science Photo Library/Photo Researchers Inc.; **212** (bottom left), David Parker/Science Photo Library/Photo Researchers Inc.; **216** (bottom right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **218–219** (centre), Minnesota Historical Society/CORBIS/MAGMA; **220** (bottom right), Artbase Inc.; **222** (centre), From Physics 11. © 2001, McGraw-Hill Ryerson Limited, a subsidiary of The McGraw-Hill Companies; **230** (top left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **231** (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **234** (centre left), © Trevor Bonderud/Firstlight.ca; **243** (bottom right), From Chemistry 11, © 2001, McGraw-Hill Ryerson Limited, a subsidiary of The McGraw-Hill Companies; **251** (top centre), © Thom Lang/The Stock Market/Firstlight.ca; **251** (top left), Artbase Inc.; **257** (bottom left), Artbase Inc.; **259** (top left), Courtesy of OPG; **260** (bottom right), Tom Pantages; **266** (bottom right), VCL-TCL/Masterfile; **267** (bottom right), Stu Forster/Allsport; **273** (centre left), Courtesy of Thermo Spectronic, Rochester, NY A Thermo Electron Business; **285** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **289** (bottom right), Paul A. Souders/CORBIS/MAGMA; **290** (top left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **291** (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **293** (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **297** (bottom left), Mike Clemmer/The Stock Market/Firstlight.ca; **302** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **303** (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **304** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **308** (top left), With Permission of The Canadian Medical Hall of Fame and artist Irma Coucill; **314** (top left), Cover of Mrs. Fulhame's Book from, <http://bip.cnrs-mrs.fr/bip10/jbiosci.htm>; **314** (centre right), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; **320–321** (centre), Malcolm Hanes/Bruce Coleman Inc.; **322** (bottom), © Marcos Welsh/Firstlight.ca; **323** (bottom left), © Pat Ivy/Ivy Images; **329** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **330** (top left), From Chemistry 11, © 2001 McGraw-Hill Ryerson Limited, a subsidiary of The McGraw-Hill Companies; **330** (top centre), From Chemistry 11, © 2001 McGraw-Hill Ryerson Limited, a subsidiary of The McGraw-Hill Companies; **330** (top right), From Chemistry 11, © 2001 McGraw-Hill Ryerson Limited, a subsidiary of The McGraw-Hill Companies; **334** (centre left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **334** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **334** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **334** (centre right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **354** (bottom), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **357** (centre right), Science Photo Library/Photo Researchers Inc.; **362** (top left), © Leonard Rue III/Visuals Unlimited Inc.; **369** (top), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **371** (top left), Adrian Holmes Photography Ltd.; **376** (bottom centre), Carl & Anne Purcell/CORBIS/MAGMA; **379** (centre left), E.F. Smith Collection/University of Pennsylvania Library; **391** (centre left), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; **391** (centre), From Chemistry 11, © 2001 McGraw-Hill Ryerson Limited, a subsidiary of The McGraw-Hill Companies; **410** (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **412** (bottom left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **413** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **413** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **418** (bottom right), © Stephen J. Krasemann/Photo Researchers, Inc.; **425** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **430** (bottom left), CNRI/Science Photo Library/Photo Researchers Inc.; **437** (top left), Stephen Frisch; **437** (top centre), Stephen Frisch; **439** (centre left), AP/Wide World Photos; **448** (bottom right), Jeff Greenberg/Photo Edit; **456** (centre left), Photo Courtesy NASA; **456** (top right), Mangelsen/Firstlight.ca; **462–463** (centre), Artbase Inc. **464** (bottom centre), Artbase Inc.; **465** (bottom left), Stephen Frisch; **465** (bottom centre), Stephen Frisch; **469** (top right), Josh Mitchell/Index Stock Imagery/Picture Quest; **473** (top left), © Jeff Daly/Stock Boston; **474** (centre right), From Chemistry 11, © 2001, McGraw-Hill Ryerson, a subsidiary of The McGraw-Hill Companies; **482** (centre right), © 1997 Brownie Harris/The Stock Market/Firstlight.ca; **483** (centre left), Stephen Frisch; **483** (centre), Stephen Frisch; **483** (centre right), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **488** (centre left), Stephen Frisch; **488** (centre), Stephen Frisch; **488** (centre right), Stephen Frisch; **491** (bottom right), © Phil Martin/Photo Edit; **506** (bottom left), From Chemistry Concepts and Applications © The McGraw-Hill Companies Inc.; **512** (bottom centre), StudiOhio; **513** (top left), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **513** (centre right), The McGraw-Hill Companies, Inc./ Photographer Pat Watson; **513** (bottom right), The Bakken Library and Museum Minneapolis; **514** (top centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **514** (centre left), Photo courtesy of Fortunato Villamagna; **517** (top left), From Chang's Chemistry. © 1998, The McGraw-Hill Companies Inc, 6th edition; **524** (bottom centre), From Chemistry Concepts and Applications © The McGraw-Hill Companies Inc.; **525** (centre), From Chemistry: The Molecular Nature of Matter and Change, © 2000, The McGraw-Hill Companies, Inc.; **526** (bottom centre), Stephen Frisch; **535** (centre right), © Charles D. Winters/ Photo Researchers Inc.; **535** (bottom left), From Chemistry Concepts and Applications © The McGraw-Hill Companies Inc.; **536** (top left), Myrleen Ferguson Cate/Photo Edit; **536** (bottom left), From Chemistry Concepts and Applications © The McGraw-Hill Companies Inc.; **538** (top right), Hulton/Archive by Getty Images; **544** (top left), Artbase Inc.; **544** (bottom right), © Chris Sharp/Photo Researchers Inc.; **546** (top right), Bill Lisenby/CORBIS/MAGMA; **546** (bottom right), AP Wide World; **547** (top left), From Chang's Chemistry. © 1998, The McGraw-Hill Companies Inc, 6th edition; **549** (top right), RC Hall Photography; **550** (centre), Artbase Inc.; **551** (top left), From Chang's Chemistry. © 1998, The McGraw-Hill Companies Inc, 6th edition; **552** (top left), Chipperfield Photography/ Photographed By Jennifer Chipperfield; **553** (top left), From Chang's Chemistry. © 1998, The McGraw-Hill Companies Inc, 6th edition; **558** (bottom left), Ken Stepnell/Bruce Coleman; **564** (top), Jose L. Pelaez/The Stock Market/Firstlight.ca; **564** (centre right), Christel Gerstenberg/CORBIS/MAGMA; **567** (top right), Artbase Inc.; **568** (bottom left), Steve Callahan/Visuals Unlimited