

families (*continued*)

oxygen, 832–837, 834*t*, 835*t*
transition metals, 144–146,
798–807, 801*t*
Faraday, Michael, 444–445,
445*f*
fats. *See* **lipids**
fatty acids, 754, 822–823, 822*f*
f-block elements, 136,
148–149, 163–164
Fermi, Enrico, 700
fertilizer production, 596–597,
831, 831*t*
fibrous proteins, 760, 760*t*
fifth-period elements, 119, 120*t*
film badges, 694, 694*f*
filtration, 12, 12*f*, 844–845,
844*f*, 845*f*
fireworks, 794–795, 794*f*
fission, 697–698, 697*f*, 698*f*,
700–701
flame tests, 130–131, 787,
787*f*, 793, 793*f*, 829, 829*f*,
833, 833*f*
flavorings, 733*f*
fluids, 330–331, 333
fluoridation, 283, 841
fluorine
covalent bonding, 183, 183*f*
electron configuration, 116*t*
electronegativity, 161, 161*t*
properties, 383*f*, 838–839,
839*f*, 840*t*
reactions, 278, 281–282
tooth decay and, 281, 841
forces
intermolecular, 203–207,
204*t*, 205*f*, 206*f*, 207*f*
nuclear, 76, 682–684, 683*f*,
684*f*
pressure and, 361–362, 361*f*,
362*f*
units of, 362
forensic chemists, 774
formula equations, 264. *See*
also **chemical equations**
formula masses, 237–239,
248–249
formula units, 190
fossil fuels, 723, 723*t*
fourth-period elements,
118–119, 118*t*
fractional distillation, 723, 723*f*
Franklin, Rosalind, 771
free energy, 548–550, 549*t*
free radicals, 836
freezing, 336, 342*t*, 345–346, 351

freezing-point depression,

448–450, 448*t*, 454–456,
455*t*, 462
freezing points, 345–347, 462,
855*t*
freons, 732
frequency, 98–99, 98*f*
fructose, 751–753, 752*f*, 753*f*,
821*f*
fuel cells, 660, 660*f*, 666
fullerene, 725
functional groups, 730–734,
730*t*, 731*t*
fusion, 695–696, 699, 699*f*

G

gallium, 118*t*, 808–809, 808*f*,
810*t*
galvanic cells. *See* **voltaic cells**
galvanizing, 662
gamma rays, 685*t*, 687, 687*f*,
693, 693*f*
gas constant, 384–385, 384*t*,
855*t*
gases, 360–388
Avogadro's law, 379–380,
379*f*, 380*f*
Boyle's law, 369–370, 369*f*,
370*f*, 396
Charles's law, 371–372, 371*f*,
372*f*, 396
from chemical reactions,
262, 262*f*, 282–283, 602
combined gas law, 374–375,
396
density of, 38, 331, 398–399,
859*t*
deviations from ideal behav-
ior, 332, 332*f*
Gay-Lussac's law, 373–374,
373*f*, 396
Gay-Lussac's law of combin-
ing volumes of gases, 378
Graham's law of effusion,
386–388, 386*f*
Henry's law, 368, 413–415,
413*f*, 414*f*
ideal gas law, 383, 383*f*
kinetic-molecular theory of,
329–332, 330*f*, 331*f*, 332*f*
measuring properties of,
398–399
molar volumes, 380–381
noble, 20, 20*f*, 135–136,
135*f*, 332
partial pressures, 365–368,
366*f*, 599

pressure, 361–367, 361*f*,
362*f*, 363*f*, 364*t*
properties, 8
solubility in water, 860*t*
stoichiometry of reactions,
381–382
gasohol, 731
gasoline, 412, 723*t*
gauge pressure, 398–399
Gay-Lussac, Joseph, 373
Gay-Lussac's law, 373–374,
373*f*, 396
Gay-Lussac's law of combining
volumes of gases, 378
Geiger, Hans, 74, 74*f*
Geiger-Müller counters, 694,
694*f*
genes, 773
genetic code, 772, 780
genetic engineering, 774–775,
774*f*
geometric isomers, 714, 714*f*
glacial acetic acid, 471
glass, 32, 338, 825
globular proteins, 760, 760*t*
gluconeogenesis, 769
glucose, 751–753, 752*f*, 753*f*,
816, 821*f*
glutamic acid, 756*f*, 758, 758*f*,
761*f*
glycerol, 731, 731*f*
glycogen, 753, 753*f*, 822*f*
glycolipids, 755
gold, 18*f*, 66*f*, 402–403, 403*f*,
798, 801*t*
Graham's law of effusion,
386–388, 386*f*
gram/mole conversions, 84
graphite, 542, 725
graphs, 30*f*, 55*f*, 57*f*
gravimetric analysis, 326–327,
846–847
gravity filtration, 844–845,
844*f*, 845*f*
greenhouse gases, 579
ground state, 100, 103, 103*f*
ground-state electron configu-
ration, 111
groups, 17. *See also* **families**
guanine, 770, 770*f*, 824*f*

H

Haber, Fritz, 597
Haber process, 597, 598–600
Hahn, Otto, 700–701, 700*f*
half-cells, 656–657, 656*f*,
662–665, 663*f*, 664*t*

half-life, 688–689, 688*f*, 688*t*,
706, 708–709
half-reaction method of bal-
ancing equations, 637–641,
650
half-reactions, 633–635
Hall-Héroult process, 671
halogens, 838–841
activity series, 285–286, 286*t*
in alkyl halides, 731*t*, 732,
732*f*, 735
properties, 147, 147*f*,
838–839, 838*f*, 839*f*, 840*t*
reactions, 278, 281–282
heat, 261, 261*f*, 531–534, 532*f*,
533*t*
Heisenberg uncertainty princi-
ple, 105
helium, 79*t*, 115, 136, 143
hemoglobin
in carbon monoxide poison-
ing, 275, 818, 818*t*
heme molecule in, 816, 816*f*
iron in, 807, 807*t*
in sickle cell anemia, 761,
761*f*
structure of, 759, 820, 820*f*
Henry's law, 368, 413–415,
413*f*, 414*f*
hertz, 98
Hess's law, 539–542, 556,
558–559
heterogeneous catalysts, 570,
579
heterogeneous mixtures, 11*f*,
12, 401*f*
heterogeneous reactions,
568–569
heterotrophs, 766
highest-occupied energy level,
116
history of chemistry
air pressure, 376–377, 376*f*
ancient Greek science, 43
combustion, 302–303, 303*f*
electrolysis, 444–445, 444*f*,
445*f*
nitrogen fertilizer produc-
tion, 596–597
nuclear fission, 700–701
organic chemistry, 715, 715*f*
periodic table, 114–115,
115*f*, 133–135, 134*f*,
172–173
homogeneous catalysts, 570
homogeneous mixtures, 11*f*,
12, 401*f*. *See also* **solutions**
homogeneous reactions, 562
homologous series, 716