

A

- Abiotic factors (ecosystems), 151
- Absorption (light), 542, 547
- Abyssal plain, 347, 360
- Acceleration, 600–601
- Acetylsalicylic acid, 513
- Acid rain, 212
- Acids, 512, 513
 - indicators of, 514–515
 - pH of, 514
 - using, 516
- Adaptation, 82, 324
 - by plants, 106
 - for pollination, 132
- Advertisement, microscopic, 476–477
- Africa, movement of, 244
- Age of Ferns, 122
- Age of Reptiles, 323
- Aggregate fruits, 135
- Air
 - balance of gases in, 204
 - as compound, 466
 - See also Atmosphere
- Air bags, 622
- Air flight, 646–647
- Air hockey, 610
- Air masses, 374, 378–379
 - fronts, 380–381
- Air pollution, 212
- Air pressure, 379, 380
- Algae, 159
- Alloys, 499
- Alps, 238
- Alternators (car), 573
- Altitude, 172, 175
- Alto cumulus clouds, 382
- Altostratus clouds, 382
- Alumina, 196
- Aluminum, 193, 196, 452–453
- Amazon rain forest, 138–139
- Amboseli National Park (Kenya), 184
- Ammonia, 515
- Ammonite fossils, 314
- Amoeba, 85
- Amphibians, 83
- Amplitude (of waves), 537, 539
- Anemometers, 388
- Angiosperms, 126
 - flower parts, 130–131
 - fruits and seeds, 134–135
 - reproduction of, 131, 132
- Animal kingdom, 78, 83
- Animals
 - cells of, 34, 35
 - exotic, 213
 - loss of habitats for, 166
 - as natural resource, 195
 - nitrogen cycle and, 207
 - plants pollinated by, 132–133
 - population cycles, 203
- Annual plants, 116
- Antarctica, 234, 316
- Anthems, 130
- Apes, 218–219
- Apollo asteroid, 423
- Aqueducts, 638
- Aquatic ecosystems, 352
- Aquatic food chain, 159
- Aquatic food web, 160
- Archaeologists, 362
- Archaeopteryx, 324
- Archimedes, 633
- Aristotle, 76
- Asexual reproduction, 50–51, 56
 - of ferns, 122
 - of mosses, 121
 - of plants, 136
- Asphalt paver operators, 622
- Aspirin, 513
- Asteroid belt, 423, 426
- Asteroids, 423, 426
 - charting, 423
 - climate and, 384

- Asthenosphere, 231, 240–241
- Atlantic Ocean, 244, 349
- Atmosphere, 372–373
 - balance of gases in, 204
 - of inner planets, 422
 - layers of, 370, 373
 - nitrogen in, 206
 - sun's effect on, 374
- Atomic force microscopes, 453
- Atomic mass, 456
- Atomic number, 453, 462
- Atoms, 450, 452–453
 - bonding of, 465
 - charge of, 570
 - definition of, 453
 - modeling, 454–455
- Auroras, 449, 474, 518–519
- Autumn colors, 200
- Avalanches, 529
- Axis
 - Earth's, 406
 - moon's, 416

B

- Bacteria, 86
 - classification of, 78
 - in deep-ocean vent, 360
 - ecosystems, 360
 - in self-cleaning fabrics, 96–97
 - on skin, 170
- Bactrian camels, 178
- Baking soda, 513
- Balanced forces, 606–607
- Balances, 18, 618
- Balancing rock, 526
- Baleen whales, 356
- Bar graphs, R29
- Barnacles, 170, 355
- Barometers, 388
- Barred spiral galaxies, 436, 437

Bases, 512–513
indicators of, 514–515
pH of, 514
using, 516

Bats, plants pollinated by, 133

Batteries
acid in, 512, 515
car, 573
chemical energy in, 572–573
circuits in, 580–581

Bauxite, 196

Bay of Fundy, 412

Beakers, 19

Bedrock, 291

Bees, 150, 476–477

Begonias, 116

Beinecke Rare Book and Manuscript Library (Yale University), 508

Berries, 135

Big Bang theory, 438

Big Crunch theory, 438

Biomes, 174–175
desert, 178–179
forest, 176–177
grassland, 180
rain forest, 138–139, 148, 176–177
taiga, 177
tundra, 177

Biotic factors (ecosystems), 151

Birds, 83
plants pollinated by, 132–133

Black dwarf stars, 435

Black holes, 434, 435

Black raspberries, 135

Black rhinoceros, 213

Bleaching (coral reefs), 182–183

Blizzards, 394

Blood, 44

Blood vessels, 42

Blue whales, 356

Bohr, Niels, 455

Boiling, 492

Boiling point, 472

Boston ferns, 122

Botanists, 140

Brachiopod fossils, 307

Branches, 107

Brass, 499

Breed, Allen, 622

Bromine, 460

Bronze, 499

Browne, Jessica, 364

Brown trout, 159

Bulbs, 136

Buoyant force, 608

Burning (of fuels), 212



Cacti, 104, 152, 178

Cactus wrens, 152

Calcite, 270

Calico cats, 56

California Current, 349

Cameras, 540

Canyons (in oceans), 347

Capacity, measurement of, R33

Cape Brett (New Zealand), 263

Carbon
isotopes of, 456

Carbon cycle, 203–205, 208

Carbon dioxide
in photosynthesis, 107
in respiratory system, 44

Cardiac muscle, 41

Cardinals, 151

Careers
asphalt paver operator, 622
botanist, 140
marine biologist, 220
meteorologist, 398
nuclear engineer, 478
photographer, 554
zoologist, 98

Caribou, 179

Carnivores, 159

Cars
air bags, 622
electric system of, 573

Cascades, 335

Cast (fossils), 305

Cats, 56

Cause and effect, R20–21

Cave crystals, 264, 270

Caves, formation of, 510

Celery, 109

Cell division, 33, 52–53, 55

Cell membranes, 34

Cells, 46
cell theory, 32–33
DNA in, 51
nucleus, 36
parts of, 34–35
reproduction, 48, 50, 52
specialized, 40–41

Cell walls, 34

Celsius scale, 20, 563

Ceres asteroid, 423

Chadwick, James, 455

Chalcopyrite, 266

Charge
of atoms, 453, 454, 570
electric, 570
in electric forces, 609

Charon, 424

Cheek cells, 40

Chemical changes, 504–505, 508

Chemical energy
in batteries, 572–573
in fireworks, 530

Chemical properties, 505

Chemical reactions, 506–507, 508
acids and bases, 513
in fireworks, 530
and heat, 508

Chemical sedimentary rocks, 277

Chemical weathering, 290

Chicxulub Crater (Mexico), 236

Chlorine, 342, 460, 464, 505

Chlorophyll, 107, 200

Chloroplasts, 34, 107

Chromosomes, 35, 36, 51
in humans, 51
in meiosis, 52, 56
mitosis and, 52–53

Cilia, 544

Cinder cone volcanoes, 253

Circle graphs, R31

- Circuits, electric**, 580–581
 parallel, 582–583
 series, 582
- Circulatory system**, 44, R6–7
- Cirrocumulus clouds**, 382
- Cirrostratus clouds**, 382
- Cirrus clouds**, 382
- Citrus fruits**, 513
- Clams**, 83
- Classes**, 92
- Classification**, 10, 76–78
 animals, 83
 bacteria, 86
 beans, 75
 definition of, 76
 fungi, 84
 grouping and naming, 90–91
 key for, 89, 94
 into levels, 81
 levels of, 92
 Linnaean system of, 77, 78, 92–93
 plants, 82
 protists, 85
 reasons for, 76–77
 rock, 273
- Clastic rocks**, 276–277
- Clay**, 490
- Clay soils**, 291
- Cleaning liquids**, 515
- Cleavage (minerals)**, 267
- Climate**
 biomes and, 175
 definition of, 384
 factors influencing, 384
 oceans and, 348–349
- Clouds**, 380, 381, 382
 fog, 379
 fronts and, 380, 381
- Coal**, 196, 198
 burning, 212
 formation of, 309
 locations of, 310
- Cockleburs**, 134–135
- Cold air masses**, 379
- Cold fronts**, 380, 381
- Colloids**, 500
- Colors**
 autumn, 200
 of light, 547
 of paint, 494
 in periodic table, 463
- Comets**, 428
- Commensalism**, 170
- Communication**, 14
 by elephants, 184
 of organism classifications, 91
 parts of flowers, 129
- Communities (ecosystems)**, 152
- Comparison**, 10
 cones and fruits, 119
 fossils and modern organisms, 319
 planetary orbits, 405
 properties of minerals, 265
 in reading, R18–19
 volume, 485
- Competition for resources**, 166–167
- Composite volcanoes**, 253
- Compound machines**, 631
- Compounds**, 464–466
- Compression (waves)**, 538
- Computer models**, 6
- Conclusion**
 locating images, 545
 melting and freezing, 469
 spring scales, 20, 613
- Condensation**, 338
- Conduction**
 of electricity, 568
 of heat, 564
- Conductors, electric**, 572
- Conglomerates**, 276–277
- Conifers**, 82, 124–125
- Connective tissue**, 41, 43
- Conservation**
 of energy, 532
 of resources, 196–197
 of soil, 292
- Consumers**, 159, 160
- Contact metamorphism**, 278
- Continental air masses**, 378
- Continental drift**, 240, 244, 316
- Continental plates**, 243
- Continental shelf**, 346–347
- Continental slope**, 346–347
- Contour plowing**, 292
- Contrasting (reading)**, R18–19
- Control variables**, 5, 13
- Convection**, 564, 565
- Convergent boundaries**, 242, 243
- Cooking, energy changes in**, 530
- Cool-water currents (oceans)**, 349
- Copernicus, Nicolaus**, 423
- Copper**, 269, 572
- Coral reefs**, 74, 154, 182–183, 358–359
- Corals**, 306, 358
- Core (Earth)**, 230, 231
- Corn, pollination of**, 133
- Corundum**, 268, 269
- Coyotes**, 152
- Crab Nebula**, 435
- Crabs**, 164, 169, 355
- Cranberry bogs**, 195
- Crescent moon**, 417
- Crest (waves)**, 536–537
- Crinoid fossils**, 307
- Cross-pollination**, 132
- Crude oil**, 193, 194
- Crust (Earth)**, 230, 231
 changes to, 232–236
 formation of, 241
 ocean floor, 346–347
- Crystals**, 264, 266–267, 270
- Ctenophores**, 544
- Cumulonimbus clouds**, 381, 382
- Cumulus clouds**, 382
- Current electricity**, 572–573
 circuits for, 580
 uses of, 584
- Currents, ocean**, 348–349, 384
- Cyanobacteria**, 86
- Cycads**, 125, 324
- Cytoplasm**, 34

D

Daddy longlegs, 98
Dale Air Deodorizing, 327
Dalton, John, 454
Darwin, Charles, 114
Darwin, Francis, 114
Data collection tools, 21
Day-night cycle, 202
Days, 406
 plant blooms and length of, 116
Decibels (db), 539
Decomposers, 159, 205
Decomposition reactions, 506, 507
Deep-ocean vents, 360
Deer, 150
Democritus, 454
Density, 488
Deoxyribonucleic acid (DNA), 36, 51
 in classification of organisms, 77
 in meiosis, 56
Dependent variables, 12
Deposition, 232, 233, 276–277
Desalination plants, 350
Deserts, 166, 178–179
Designer bacteria, 96–97
Designing experiments (motion), 605
Details, supporting, R16–17
Detergents, 513
Diamonds, 268–270
 mining, 497
Diaphragm, 44
Diatom fossils, 307, 312
Dichotomous key, 94
Dicotyledons, 134
Diffraction, 549
Digestive system, 44, R5
 cells in, 40
 organs in, 42
Dimetrodon, 324
Dinosaurs, 301, 302, 322, 326–327

Disease, air pollution and, 212
Disinfectants, 515
Dissolving, 492. *See also* Solutions
Distance
 gravitational force and, 616–617
 with wheel-and-axles, 635
 work and, 630
Divergent boundaries, 242
Diversity, 154
Diving, 614
DNA. *See* Deoxyribonucleic acid
Dolphins, 354, 364
Doorstops, 643
Doppler radar, 388–392, 394
Dormancy (plants), 116
Double helix (DNA), 51
Double refraction, 548
Double replacement reactions, 506, 507
Drawing conclusions, 5, 14
 drop prints, 17
 fossils, 303
 germinating seeds, 105
 hydras, 165
 measuring speed, 597
 in reading, R24–25
 rock classification, 273
Drinking water, 195, 340
Drupes, 134
Dry ice, 473
Dunes, 233
Dunkleosteus, 318
Dust Bowl, 292
Dust storms, 292

E

Eagle Nebula, 434
Ears, 42
Earth
 days on, 406
 fossils and history of, 314–315
 gravitational force on, 615
 as inner planet, 422, 423
 layers of, 230–231, 241
 orbit of, 617

 seasons on, 408–409
 water on, 338
 years on, 407
Earthquakes, 248–249
 measuring strength/damage, 250–251
 waves from, 536
Eclipses, 410–411
Ecosystems, 150–151
 aquatic, 352
 changed by human activities, 212–216
 competition for resources in, 166–167
 coral reefs, 182–183
 in deep-ocean vents, 360
 definition of, 150–151
 diversity in, 154
 energy in, 158–159
 intertidal, 354–355
 natural cycles in, 202–203
 near-shore, 356
 open-ocean, 356–357
 of the past, 320–321
 populations in, 152–153, 167
 protection of, 216
 wetlands, 210
Efficiency, 636
Effort arm (lever), 632
Effort force, 632, 641, 642
Egg cells, 50, 52
 angiosperm, 132
 of flowers, 130
 of plants, 133
Electrical energy, 529, 531
 lightning, 532
 from ocean waves, 586–587
 See also Electricity
Electric forces, 609
Electricity
 circuits, 579, 580–583
 conduction of, 568
 current, 572–573, 584
 distribution of, 575
 energy sources for generation of, 576
 hydroelectric power, 574
 measurement of, 581

- nuclear power, 575
 - production of, 574–575
 - static, 570
 - Electric system (cars), 573**
 - Electromagnetic spectrum, 540, 547**
 - Electromagnetic waves, 540–541**
 - Electromagnets, 584**
 - Electron microscopes, 32**
 - Electrons, 453–455, 465**
 - charge of atoms and, 570
 - flow of, 572
 - Elements, 460–461**
 - compounds and, 464
 - periodic table, 462–463
 - Elephants, communication by, 184**
 - Elliptical galaxies, 436, 437**
 - El Niño, 384**
 - Emulsions, 500**
 - Endangered species, 213, 216**
 - manatees, 220
 - Endangered Species Act of 1973, 216**
 - Endocrine system, 45**
 - Energy**
 - conservation of, 532
 - definition of, 528
 - electrical, 529, 531
 - food chains, 159
 - food webs, 160–161
 - forms of, 529
 - kinetic, 528, 529
 - light, 529, 531, 542
 - nuclear fission, 478
 - from ocean waves, 586–587
 - potential, 528, 529
 - solar, 531, 576
 - sound, 529
 - sources of, 158–159
 - thermal, 562–563
 - transformations of, 530–531
 - in waves, 534, 536
 - See also* specific types, e.g.,
Thermal energy
 - Energy pyramid, 162**
 - Energy resources, 198**
 - Entomologists, 398**
 - Environments, 147**
 - natural resources from, 194–195
 - Enzymes, 44**
 - Epicenter, 249**
 - Epithelial tissue, 41**
 - Equator, temperature at, 374**
 - Erosion, 232, 233, 288**
 - Esophagus, 44**
 - Estuaries, 214**
 - Euglena, 78**
 - Eunomia asteroid, 423**
 - Eurasian plate, 240**
 - Eurypterids, 323**
 - Evaporation, 338–341**
 - Everglades (Florida), 215**
 - Evergreen trees, 176**
 - Excretory system, 45**
 - Exosphere, 373**
 - Exotic species, 213**
 - Experiments, 4–5**
 - brightness, 431
 - conducting, 5
 - erosion, 289
 - filtering polluted water, 211
 - investigations vs., 6
 - method for, 13
 - planning, 4
 - variables in, 13
 - Extinction, 213, 216, 322–323**
 - Extrusive igneous rock, 274**
 - Eye (human), 42**
 - Eye (hurricanes), 392**
- 
- Fahrenheit scale, 563**
 - Fallingwater (forest house), 189**
 - Falls of the Ohio State Park, 320–321**
 - Families, 92**
 - in periodic table, 463
 - Farming**
 - contour plowing, 292
 - of trees, 194
 - Fault, 248**
 - Ferns, 122–123**
 - Fertilization, 50**
 - of angiosperms, 132
 - Fiber optics, 547**
 - Fiddleheads, 122**
 - Filaments (flowers), 130**
 - Filaments (light bulbs), 572**
 - Fireworks, 502, 530**
 - First quarter moon, 416–417**
 - Fish, 83**
 - coral reefs and, 358
 - fossils of, 306
 - as natural resource, 195
 - schools of, 352
 - See also* specific types, e.g.,
Brown trout
 - Fleas, 168**
 - Flight, 646–647**
 - Florida, 128**
 - Flowering plants, 82**
 - day length and, 116
 - reproduction of, 51
 - seeds of, 124
 - Flowers, 38**
 - parts of, 130–131
 - pollination and, 132–133
 - Fluorescence (minerals), 266**
 - Fluorite, 267**
 - Focus (earthquakes), 249**
 - Fog, 379**
 - Food**
 - made by plants, 107
 - in open-ocean zone, 356–357
 - spoilage of, 508
 - Food chains, 158, 159**
 - in food webs, 160
 - Food webs, 160–161, 162**
 - Forces, 600–601**
 - acceleration and, 600–601
 - balanced, 606–607
 - buoyancy, 608
 - definition of, 600–601
 - electric, 609
 - friction, 610

gravitational, 614–615
gravity, 608
with inclined planes, 641
with levers, 632–633
magnetic, 608, 609
nuclear, 608
with pulleys, 634
surface tension, 608
unbalanced, 607
with wedges, 642
with wheel-and-axles, 635
work and, 630. *See also* Work

Forceps, 21

Forest biomes, 176–177

Forests
as ecosystem, 150, 151
lumber and paper from, 194, 195
succession in, 203
temperate deciduous, 176–177
tropical, 154, 176, 214
in United States, 198

Fossil fuels
burning, 212
for electricity generation, 576
formation of, 308–309
locations of, 310

Fossils
changes through time and, 324
continental drift and, 316
continent movement and, 244
definition of, 304
dinosaur, 301, 302
Earth's history and, 314–315
ecosystems of the past and, 320–321
formation of, 304–305
index, 315
life in the past and, 322–323
in limestone, 277
in rocks, 238
types of, 306–307

Fowler, Alex, 96–97

Frame of reference, 598

Frequency (sound), 538, 539

Fresh water, 340–341, 350

Friction, 610

Friend, Jordan, 442

Fronds, 122

Fronts, 380–381

Frostbite, 394

Fruits
of angiosperms, 134–135
citrus, 513
comparison with cones, 119
formation of, 132
types of, 134–135

Fuels
burning, 212
fossil, 308–310

Fulcrum, 632, 633

Full moon, 416

Fungi, 84

Fusion, 432, 433, 460



Galaxies, 436–437
Milky Way, 403, 435, 436

Galileo, 418

Gases, 471
in air, 204
in atmosphere, 372
in liquids, 499
in water, 470

Gaspra asteroid, 423

Gathering data (owl pellets), 157

Geiger, Matthew, 588

Generating stations, 531

Generators, 574, 575

Genes, 51

Genesis spacecraft, 440–441

Genetic variations, 56
for land-mine-detecting plants, 67

Genus, 91, 92

Geodes, 270

Geothermal energy, 576

Germination (of seeds), 105, 107

Geysers, 258

Giant pandas, 153

Gibbous moon, 417

Gila monsters, 152

Ginkgo, 125

Giraffes, 90

Giribet, Gonzalo, 98

Glacial troughs, 235

Glaciers, 468
changes of Earth's surface from, 234–235
meltwater from, 396–397

Gliders, 646–647

Global Positioning System (GPS), 552–553

Global winds, 383

Glucose, 107, 109

Gneiss, 279

Gobi, 178

Goddio, Franck, 363

Gold, 269, 462

GPS. *See* Global Positioning System

Graduate, 19

Grafting, 136

Grains, 130

Grams, 618

Grand Canyon (Arizona), 272

Granite, 275, 280, 284

Graphite, 268, 270

Graphs, R29–31

Grasses, 130, 133

Grasslands, 180
competition for resources in, 166
disruptions to, 214
protection of, 216
Serengeti, 73

Gravitational force, 614–615
distance and, 616–617
mass and, 616–617

Gravitropism, 114

Gravity, 608, 614, 615, 618
air pressure and, 379
changes of Earth's surface from, 232, 233
as force, 600
gravitropism, 114
star formation and, 433

Gray wolves, 180

Great Falls (Potomac National Park), 282

Great Wall of China, 280

Green tree snake, 78

Groundwater, 339
 as freshwater source, 340–341
 preservation of, 342
Growth, 50–51
Growth charts, 51
Gulf Stream, 349
Gymnosperms, 124–125

H

Habitats, 152–154
 destruction of, 219
 loss of, 166, 219
Hahn, Otto, 478
Hail, 339
Halite, 269, 464
Halley's comet, 428
Hallucigenia, 322
Hand lenses, 20
"Hanging" valleys, 234
Hardness (minerals), 268–269
Hawai'i, 254
Hawaiian Islands, 254
Hawks, 153
Hearing, loud sounds and, 539
Heart, 42
Heat, 564–565
 changes in state and, 473
 chemical reactions and, 508
 conduction of, 564
 definition of, 564
 infrared waves, 540
 from lightning, 532
See also Thermal energy
Helium, 461
Heracles, 363
Herakleion (ancient city),
 362–363
Herbalists, 76
Herbivores, 159
Hermit crabs, 164, 170
Hérons, 94
Herpetologists, 68
Hertz, 539
Hertzsprung, Ejnar, 433

**Hertzsprung-Russell (H-R)
 diagram**, 432, 433
Hickory trees, 203
Honey badger, 168
Honeyguide bird, 168
Hooke, Robert, 32, 388
Hoover Dam, 525
Hormones, 45
Hornworts, 121
Horsehead Nebula, 435
Hosts, 168
Hot spots, 254
Hot springs, 336
H-R diagram. *See* Hertzsprung-
 Russell diagram
Human activities
 ecosystems changed by,
 212–216
 natural cycles and, 208
Human body
 chromosomes in, 51
 circulatory system, 44, R6–7
 digestive system, R5
 endocrine system, 45
 excretory system, 45
 immune system, R8–9
 integumentary, 44
 muscular system, R12–13
 nervous system, R14–15
 reproductive system, 45
 respiratory system, 44, 45
 skeletal system, 44, R10–11
 skin, R1
 water in, 340
Humidity, 378
 of air masses, 380
 relative, 379
Hummingbirds, 154
Humus, 291, 292
Hurricanes, 386, 392–393
Hydrochloric acid, 505, 513, 516
Hydroelectric dams, 195, 574
Hydroelectric power, 574
Hydrogen, 461, 504
 isotopes of, 456
 used by stars, 434, 435

Hydrogen chloride, 514
Hygrometers, 379
Hypothermia, 394
Hypothesis, 4
 testing, 4, 6
Hypothesizing, 11
 electric charges, 569
 losing heat, 561
 mixing and unmixing, 495
 ramps, 639

I

Ice
 changes of Earth's surface
 from, 234–235
 glaciers, 468
 molecules in, 471
Ice hotel, 483
Iceland spar, 548
Ice sculptures, 487
Identifying variables, 4, 12
 changing energy, 527
Igneous rock, 274–275, 280
 formation of, 285
 intrusive vs. extrusive, 275
 at plate boundaries, 286
Ignition, car, 573
Immune system, R8–9
Impacts, changes to Earth's
 surface from, 236
Incas, 288
Inclined planes, 640–641
 screws as, 644
Independent variables, 12
Index fossils, 315
Indian plate, 240–241
Indicators, 514–515
Indigestion, 513
Inertia, 602, 617
Inference, 10
 acids and bases, 511
 air pressure, 377
 building electric circuit, 579
 classifying elements, 459
 mixing of waters, 9

plant and animal cells, 31
Infrared waves, 540
Inner core, 231
Inner planets, 422–423
Inquiries
 scientific method, 4–5
 skills for, 10–14
Insects, plants pollinated by,
 132–133
Insulation (thermal energy),
 566, 588
Insulators
 electrical, 572
 thermal, 566
Integumentary system, 44
Interpreting data, 5, 11
 comparing climates, 149
 kinds of changes, 503
 locating earthquakes, 247
 mapping ocean floor, 345
 world biomes, 173
Intertidal ecosystems, 354–355
Intertidal zone, 354, 355
Intrusive igneous rock, 275
Invertebrates, 83
Investigations, 5, 6, 12
Iron, 193
Irregular galaxies, 436, 437
Irrigation water, 397
Islands, Hawaiian, 254
Isotopes, 456

J

Jellyfish, 357
Jet stream, 383
Joule (J), 631
Juno asteroid, 423
Jupiter, 424
Justice, scales of, 628

K

Kepler, Johannes, 407, 423
Kilowatt-hour (kWh), 581
Kinetic energy, 528, 529
Kingdoms, 78, 92
 animal, 83

 differences/similarities
 among, 86
 divisions of, 91
 plant, 82
Kirigami, 491
Knives, 643
Krill, 356
Kudzu, 212–213
Kurata, Travis, 648
Kursk (Russian submarine),
 620–621

L

La Brea Tar Pits (Los Angeles),
 321, 322
Ladakh region (India), 396–397
Lake Como (Switzerland), 341
Land breezes, 348
Land food web, 160, 162
Land-mine-detecting plants,
 66–67
Large intestine, 44
Large Magellanic Clouds, 436
Latitude, climate and, 175
Lava, 275, 278, 285, 562
Law of conservation of energy,
 532
Law of inertia, 602
Leaf cells, 40
Leaves
 of angiosperms, 126
 chloroplasts in, 34, 107
 development of, 107
 growth from cuttings, 136
 as plant organs, 45
Leeuwenhoek, Anton van, 32
Legumes, 206
Lemon juice, 515
Lemurs, 213
Length, measurement of, R32
Lepidodendrons, 324
Levers, 632–633
Light
 auroras, 449, 474, 518–519
 behavior of, 546–547
 diffraction, 549
 Raman effect, 554
 reflection, 546–547
 refraction, 548
 speed of, 548
 ultraviolet, 541
Light bulbs, 572–573
Light energy, 529, 531, 542
Lightning, 207, 376, 390, 474,
 532, 568
Light waves, 540–541
Lilies, 55
Limestone, 277
Line graphs, R30
Linnaean system of
 classification, 77, 78, 91–93
Liquids, 471
 cleaning, 515
 gases dissolved in, 499
 surface tension of, 608
 tools for measuring, 18
 water, 470
Lithosphere, 230, 240, 241
Liver, 42, 44
Liverworts, 110, 121
Living things, classification of,
 76–78. *See also* Organisms
Lizards, 487
Load (lever), 632
Logging (Indonesia), 219
Log splitters, 642
Loma Prieta earthquake, 250
Long-day plants, 116
Long Island, New York, 235
Looping roller coasters, 612
Loudness, 539
Lumber, 194
Lunar cycle, 417
Lunar eclipses, 410
Lungs, 42, 44
Lynx, 167

M

Maastrichtian Miasma, 327
Machines, 631, 636. *See also*
 Simple machines
Magellanic Clouds, 436
Magma, 252–254, 274–275, 285

- Magnetic field**, 575
Magnetic force, 608, 609
Magnetism
 Earth's poles, 231
 electricity generation and, 575
 electromagnets, 584
 as force, 600
Magnifying boxes, 21
Magnitude (earthquakes),
 250–251
Magnolia trees, 118
Main ideas, identifying, R16–17
Main sequence (H-R diagram),
 433
Mak, Roger, 182
Mammals, 83, 354
Mammoth Hot Springs, 336
Mammoths, change over time
 in, 324
Manatees, 220
Mantle, 230, 231, 241
Maps, weather, 388, 389
Marathon runners, 46
Marble, 279, 280
Mariana Trench, 347
Marine biologists, 220
Marine organisms, 350
Maritime air masses, 378
Marmots, 177
Mars, 422, 423
Mass, 488
 atomic, 456
 gravitational force and,
 614–617
 measurement of, R34
 motion and, 601
 physical changes to, 491
 weight vs., 618
Mass extinctions, 322–323
Mastodon fossils, 314
Matter
 atoms, 454–455
 changes in state of, 472–473,
 492
 chemical changes in, 504–505
 chemical properties of, 505
 chemical reactions in, 506–
 507
 compounds, 464–466
 definition of, 486
 elements, 460–461
 isotopes, 456
 physical changes to, 490–491
 physical properties of, 486–
 489
 states of, 470–471, 474
Mayfly nymph, 159
Measurement, 11
 of capacity, R33
 customary systems for, R35
 of earthquake strength/
 damage, 250–251
 of electricity, 581
 of length, R32
 of mass, R34
 metric, R32–35
 speed, 599
 tools for, 18–20
 velocity, 599
 of weight, 618
Measuring cups, 19
Mechanical waves, 536
Medicines (from rain forests),
 138–139
Mediterranean Sea, 362–363
Meiosis, 54–56
Meitner, Lise, 478
Melting, 492
 of rock, 285
Melting point, 472
Meltwater, 396–397
Mendeleev, Dmitri, 462
Mercalli intensity scale, 251
Mercury (planet), 407, 422, 427,
 442
Mesosphere, 373
Mesquite, 178
Metals, 193, 196, 452–453, 461
 chemical reactions with, 508
 as conductors, 572
 in minerals, 269
 use of, 193
Metamorphic rock, 278, 280
 formation of, 285
 at plate boundaries, 286
Metamorphism, 278
Meteor Crater, 236, 426
Meteorites, 236, 426
Meteorologists, 388, 389, 398
Meteors, 426–427
Meteor shower, 427
Meters (m), 631
Metric measurements, R32–35
 capacity, R33
 length, R32
 mass, R34
Metric rulers, 18
Metric tape measure, 18
Mexia, Ynes Enriquetta Julietta,
 140
Mica, 267
Microgravity, 618
Micropaleontologist, 328
Microscopes, 21, 32, 453
Microscopic advertisement,
 476–477
Microwaves, 540
Mid-ocean ridges, 242, 347
Milky Way Galaxy, 403, 435, 436
Milner, Angela, 327
Mimosa tree, 115
Minerals
 definition of, 266
 formation of, 270
 in fossils, 304
 hardness and uses of, 268–269
 properties of, 266–267
 in water cycle, 341
See also Rocks
Mining
 compounds in, 466
 diamonds, 497
 in oceans, 350
 resources from, 193, 194
Mirrors, 546
Mitochondria, 34, 35, 40
Mitosis, 52–53

Mixtures, 496
colloids, 500
emulsions, 500
separating, 497
solutions and, 498
suspensions, 500

Modeling, 6, 14
atoms, 454–455
changes in rock, 283
Earth's layers, 229
ecosystem in a jar, 353
exploring groundwater, 337
paper recycling, 191
planetary orbits, 405

Mohs hardness scale, 268

Mold (fossils), 305

Molds, slime, 85

Molecules, 471

Moment magnitude, 250, 251

Monocotyledons, 134

Moon(s)
craters on, 236
eclipses, 410–411
light reflected by, 546
orbit of, 414
of outer planets, 424
phases of, 416–417
tides and, 412

Morning glories, 114

Mosses, 82, 110, 120–121

Moths, 133

Motion
acceleration, 600–601
balanced/unbalanced forces
and, 606–607
describing, 598–599
friction and, 610
inertia, 602
laws of, 601, 602
speed, 599
velocity, 599

Motor, starter (car), 573

Mountains
formation of, 285
in oceans, 347
volcanoes. *See* Volcanoes
• **Fuji (Japan)**, 227

Mount Nyiragongo (Democratic Republic of the Congo), 294–295

Mount St. Helens (Washington state), 256–257

Mount Shasta (California), 394

Mud pots, 560

Mudstone, 280

Multicellular organisms, 40, 46

Multiple fruits, 135

Muscle cells, 33, 40

Muscles, 43, R12–13
cardiac, 41
in digestive system, 44
smooth, 40, 41

Muscle tissue, 41

Muscular system, 44, R12–13

Mushrooms, 84

Musical instruments, 538, 539

Mussels, 170, 355

Mutualism, 168

N

Natural cycles, 202–203
carbon cycle, 204–205
humans' effect on, 208
nitrogen cycle, 206–207

Natural gas, 194, 196, 198
formation of, 308–309
locations of, 310

Natural History Museum (London), 326–327

Natural indicators, 514

Natural resources, 192–193
definition of, 192
distribution of, 198
from the environment,
194–195
managing, 196–197

Neap tides, 412

Near-shore ecosystems, 356

Nebulae, 430, 433, 435

Nectar, 132, 133

Needles, 643

Negative gravitropism, 114

Neon, 463

Neptune, 424, 425

Nerve tissue, 41, 43

Nervous system, R14–15

Net force, 607

Neutrons, 453, 456

Neutron star, 434, 435

Newhall, Chris, 295

New moon, 416, 417

Newton, Isaac, 601, 602

Newton (N), 607, 618, 631

Niches, 153, 166

Night, 406

Night-blooming plants, 116

Nimbostratus clouds, 380, 382

Nitrogen, 466

Nitrogen cycle, 203, 206–208

Nitrogen fixation, 206

Nonflowering plants, 124

Nonmetals, 461

Nonrenewable resources, 196

Nonvascular plants, 110

Norphel, Chewang, 397

North America, movement of, 244

North American plate, 241

Northern Hemisphere
aurora borealis, 519
seasons in, 408–409

North Pole, 231

Nose, 42, 44

Nuclear energy, 531, 575

Nuclear engineers, 478

Nuclear fission, 478

Nuclear forces, 608

Nuclear membrane, 34, 35
in meiosis, 55
mitosis and, 52

Nuclear power, 575

Nuclei (atoms), 456

Nucleolus, 36

Nucleus, cell, 34–36, 51

Number, atomic, 453

Number skills. *See* Using numbers

O

Oak trees, 203

- Observation**, 6, 10
 communicating, 14
 of invisible things, 451
 modeling lungs, 39
 plate movement, 239
 properties of minerals, 265
 recording, 13
 root growth, 113
- Obsidian**, 274, 280
- Oceanic crust**, 241, 347
 volcano formation and, 252
- Ocean plates**, 243, 286
- Oceans**
 climate and, 348–349, 384
 coral reefs, 74, 154, 182–183,
 358–359
 deep-ocean vents, 360
 energy resources from, 195
 floor of, 346–347
 intertidal ecosystems,
 354–355
 near-shore ecosystems, 356
 open-ocean ecosystems,
 356–357
 resources in, 350
 tides, 412
 water color in, 344
 zones in, 354
- Oil**, 196
 burning, 212
 crude, 193, 194
 use of, 193
- Oil spills**, 212, 213
- Old Faithful**, 258
- Omnivores**, 159
- One-celled organisms**
 discovery of, 32
 protists, 85
Stentor, 33
- Opaque materials**, 550
- Open-ocean ecosystems**,
 356–357
- Orangutans**, 218–219
- Orbits**
 days and years, 406–407
 gravitational force and, 617
 modeling planetary, 405
 of moon, 414
 revolutions, 407
- Orchids**, 78, 103, 170
- Orders**, 92
- Organelles**, 34, 35
- Organisms**, 46
 classification of, 76–78
 definition of, 46
 in ecosystems, 150
 fossilized, 306, 321
 genetic variations in, 56
 growth of, 50–51
 interactions of, 168–169
 marine, 350
 mitosis in, 52–53
 multicellular, 40, 46
 niches of, 153
 in ocean zones, 356
 temperature/moisture levels
 for, 151
- Organs**, 42–43
 definition of, 42
 systems of, 44–45
- Organ systems**, 46
- Origami**, 491
- Outer core**, 231
- Outer planets**, 424–425
- Ovary (flowers)**, 130, 133
- Ovules (flowers)**, 130
- Owls**, 153
- Oxpecker**, 169
- Oxygen**, 461, 504
 in air, 466
 in circulatory system, 44
 in photosynthesis, 107
 in respiratory system, 44
- Oxygen cycle**, 203
- Oysters**, 350
- Ozone**, 372
- P**
- Pacific Ocean**, 244
 California Current, 349
 El Niño, 384
 Mariana Trench, 347
- Pacific plate**, 240, 254
- Pan balance**, 18
- Pancreas**, 40, 42, 44
- Pandas**, 153
- Pangea**, 244
- Parallel circuit**, 582–583
- Paramecium**, 85
- Parasites**, 168, 169
- Parrotfish**, 359
- Partial eclipses**, 410, 411
- Pears**, 134
- Peas**, 114
- Pedestal rock**, 526
- Penicillium**, 84
- Penumbra**, 410
- Perennial plants**, 116
- Periodic table**, 462–463
- Periods (in periodic table)**, 463
- Personal Locator**, 552–553
- Petals, flower**, 130
- Petrified wood**, 305
- Petroleum**, 350
 formation of, 308–309
 locations of, 310
See also Oil
- Phases**
 of moon, 416–417
 of planets, 418
- Phloem**, 45, 108
- Photographers**, 554
- Photosynthesis**, 107, 158, 204
- Phototropism**, 114
- Photovoltaic cells**, 576
- pH scale**, 514, 515
- Phyla**, 91, 92
- Physical changes**, 490–492
- Physical properties**, 486–489
- Physical weathering**, 290
- Phytoplankton**, 204
- Pineapples**, 135
- Pistils**, 130, 135
- Pitchford, Tom**, 220
- Pitch (of sound)**, 539
- Planetary nebulae**, 434

Planets

- inner, 422–423
- length of years, 407
- outer, 424–425
- phases of, 418

Plankton, 355

Plant kingdom, 78

Plants

- angiosperms, 126
- annual, 116
- asexual reproduction of, 136
- carbon cycle and, 204
- cells of, 34, 35
- classification of, 82
- dicotyledons, 134
- egg cells of, 133
- energy sources for, 158
- exotic, 213
- ferns, 122–123
- food made by, 107
- gymnosperms, 124–125
- hornworts, 121
- land-mine-detecting, 66–67
- liverworts, 121
- long-day, 116
- Mexia's collection of, 140
- monocotyledons, 134
- mosses, 82, 110, 120–121
- needs of, 106–107
- night-blooming, 116
- nitrogen cycle and, 207
- nonflowering, 124
- nonvascular, 110
- organs/organ systems in, 45
- as parasite hosts, 168
- perennial, 116
- reproduction in, 51, 53
- rhythms of, 116
- sensitive to touch, 114, 115
- short-day, 116
- tissues, 45, 108
- tropisms and, 114–115
- vascular, 108–109

See also specific types, e.g.,

Begonias

474

n, 85

aries, 286

Plates, 240–241

- boundaries of, 242–243, 286
- change to Earth's surface from movement of, 244
- earthquakes, 248
- oceanic, 243, 286, 347
- volcano formation and, 252, 254

Plate tectonics, 241

Plows, 643

Plum-pudding model (atoms), 454–455

Pluto, 407, 424, 425

Polar air masses, 378

Poles

- of Earth, temperature at, 374
- of magnets, 608

Pollen, 125, 132–133

Pollen tubes, 133

Pollination, 132–133, 150

Pollution, 212

- water, 342

Pome, 134

Ponce de León, Juan, 128

Poole, Joyce, 184

Populations (in ecosystems), 152–153, 167

Positive gravitropism, 114

Positive phototropism, 114

Potassium, 462

Potatoes, 136

Potential energy, 528, 529, 531

Prairie, 214

Precipitation

- acid in, 212
- air masses in, 379
- definition of, 339
- water cycle and, 202, 203
- wind and, 384

Predators, 167

Prediction, 10

- elodea, 201
- tracking hurricanes, 387
- of weather, 388–389

Preservation, water, 342

Pressure

- air, 379, 380

- changes in state and, 473
- in oceans, 357

Prevailing westerlies (wind), 383

Prey, 167

Primary consumers, 159, 160

Primary succession, 202

Prisms, 547

Producers, 158

Proteins, 206

Protists, 85, 308

Protons, 453, 456

Pseudopodia, 85

Pulleys, 631, 634, 648

Pumice, 280

Pumpkins, 114

P waves, 249

Pyrite, 266

Q

Quartz, 268–269

Quartzite, 284

Quintuplets, 29

R

Radiation of heat, 565

Rain, 339

- acid, 212

Rain Forest Aerial Trams (Costa Rica), 636

Rain forests, 138–139, 148, 176, 177

Raman, Sir Chandrasekhara Venkata, 554

Ramps, 640, 641

Rarefaction, 538

Reactivity, 505

Receptacles, electric, 572

Recycling, 193, 196

Red fox, 176

Red giants, 434

Red spider mites, 168

Redwood trees, 190

Reflection, light, 546–547

Reflexes, 41

Refraction, 548

- Regional metamorphism**, 278
- Relative humidity**, 379
- Renewable resources**, 196
- Replacement reactions**, 506, 507
- Reproduction**, 50–51
- of angiosperms, 126, 131, 132
 - asexual, 50–51, 56
 - of conifers, 125
 - of ferns, 122–123
 - of flowering plants, 51
 - meiosis, 54–55
 - mitosis, 52–53
 - of mosses, 121
 - of plants, 136
 - by seeds, 124
 - sexual, 50–51, 56
- Reproductive cells**, 48, 50, 52
- Reproductive system**, 45
- Reptiles**, 68, 83, 323
- Resistance arm (lever)**, 632
- Resistance force (lever)**, 632
- Resources**
- competition for, 166–167
 - conservation of, 196–197
 - energy, 198
 - nonrenewable, 196
 - in oceans, 195, 350
 - renewable, 196
- See also* Natural resources; specific resources, e.g., Water
- Respiration**, 35
- carbon dioxide in, 44–45, 204
 - plant, 107
- Respiratory system**, 44, 45
- Reuse (conservation)**, 196, 197
- Revolution**
- of Earth, 406
 - of moon, 416–417
- Rhinoceros**, 169, 213
- Rhizoids**, 110
- Richter, Charles**, 250
- Richter scale**, 250, 251
- Rift**, 242
- Roadrunners**, 152
- Robots**
- Genesis* spacecraft, 440–441
- Rock cycle**, 284–286
- Rock hunting**, 296
- Rocks**
- age of, 314
 - balancing, 526
 - fossils in, 238
 - igneous, 274–275
 - melting of, 285
 - metamorphic, 278
 - plates of, 240
 - properties of minerals and, 266–267
 - sedimentary, 276–277, 314–315
 - uses of, 280
 - weathering/erosion of, 232, 233
- See also* specific types, e.g., Bauxite
- Rock salt**, 269
- Roller coasters**, 612
- Roots**, 45, 106, 107
- thigmotropism and, 114–115
- Rotation, definition of**, 406
- Royal Quarter of Alexandria**, 363
- Rulers, metric**, 18
- Runners, plant**, 136
- Russell, Henry Norris**, 433
- Russian steppe**, 180
- Rutherford, Ernest**, 455
- Rutherfordium**, 460
- S**
- Safety**, 22, R36
- Saguaro cactus**, 152
- Sailboats**, 636
- Salivary glands**, 44
- Saltwater resources**, 350, 464, 465
- Sand**, 461
- mining, 350
- Sand dunes**, 233
- Sandstone**, 276
- Sandy soil**, 291
- Satellites**, 424
- gravitation pull of Earth on, 615
 - weather, 388, 389
- Saturn**, 424
- Savannas**, 180
- Scales**, 20, 628
- Scanning electron microscopes (SEMs)**, 21
- Scarlet macaw**, 80
- Scavengers**, 159
- Schist**, 279
- Science projects**
- ancient ecosystem recreation, 329
 - aquatic food web diagram, 365
 - bottle tornado, 399
 - chemical change, investigations, 521
 - desert leaves, 185
 - dichotomous key, 99
 - earthquake-resistant buildings, 259
 - electric circuits, 589
 - force and mass, 623
 - growing plants from seeds, 141
 - growing plants from spores, 141
 - identifying pasta, 99
 - kaleidoscopes, 555
 - magic balloon, 479
 - making simple machines, 649
 - people's effect on ecosystems, 185
 - petroleum moving through rocks, 329
 - physical changes, 521
 - plants making carbon dioxide, 221
 - pulleys, 649
 - reducing friction, 623
 - sandstone rock, 297

- saving resources, 221
- soil, 297
- spinning planets, 443
- sun's angle, 443
- S waves study, 259
- temperature and volume, 479
- travels of electricity, 589
- vibrating strings, 555
- water cycle model, 365
- water movement in cells, 69
- weather station design, 399
- Scientific inquiries.** *See* Inquiries
- Scientific method,** 4–5
- Scientific names,** 91
- Scorpions,** 152
- Screws,** 644
- Sea anemones,** 164, 169
- Sea breezes,** 348
- Sea-floor spreading,** 242, 244
- Sea salt,** 350
- Seasonal cycle,** 202
- Seasons,** 408–409
- Sea sparkles,** 85
- Sea turtles,** 216
- Sea urchins,** 83
- Secondary consumers,** 159, 160
- Secondary succession,** 203
- Sediment,** 232–233
- Sedimentary rock,** 276–277, 280, 314–315
 - formation of, 284
 - at plate boundaries, 286
- Sedna,** 424, 425
- Seeds**
 - of angiosperms, 134–135
 - needs of, 107
 - reproduction by, 124
- Seesaws,** 632
- Seismographs,** 249, 250
- Self-cleaning fabrics,** 96–97
- Self-pollination,** 132
- SEMs (scanning electron microscopes),** 21
- Sense organs,** 42
- Sepals,** 130
- Separating mixtures,** 497
- Sequence,** R22–23
- Sequence (new cell production),** 49
- Serengeti grassland,** 73
- Series circuit,** 582
- Sexual reproduction,** 50–51, 56
 - of angiosperms, 126
 - of ferns, 122
 - of mosses, 121
- Shale,** 276–278, 280
- Shepherd, Marshall,** 398
- Shield volcanoes,** 252, 253
- Ship Rock (New Mexico),** 228
- Shooting stars,** 426
- Shoots (plants),** 45, 107
- Short-day plants,** 116
- Silicon,** 460, 461
- Silk,** 458
- Silty soil,** 291
- Silver,** 269, 463
- Simple machines,** 631
 - inclined planes, 640–641
 - levers, 631–633
 - mechanical advantage with, 636
 - pulleys, 634
 - screws, 644
 - wedges, 642–643
 - wheel-and-axles, 631, 635
- Single-celled organisms.** *See* One-celled organisms
- Single replacement reactions,** 506, 507
- Skateboarding,** 596
- Skeletal system,** 44, R10–11
- Skeletons (invertebrates),** 83
- Skiing,** 595
- Skills, inquiry,** 10–14
- Skin,** 42, R1
 - bacteria on, 170
- Skunks,** 151
- Slate,** 278, 280
- Sleet,** 339
- Slime molds,** 85
- Small intestine,** 41, 44
- Small Magellanic Clouds,** 436
- Smits, Willie,** 218–219
- Smooth muscles,** 40, 41
- Snail fossils,** 307
- Snakes**
 - green tree, 78
 - two-headed, 68
- Snapdragons,** 115, 116
- Snow,** 339, 394
- Snowboarding,** 595
- Snowshoe hares,** 167
- Snowy owls,** 156
- Soap,** 513, 516
- Sodium,** 462, 464, 505
- Sodium hydroxide,** 513, 514
- Soil**
 - conservation of, 292
 - formation of, 290–291
 - as natural resource, 195
 - as nonrenewable resource, 196
 - variations in, 291
- Solar corona,** 411
- Solar eclipses,** 410–411
- Solar energy,** 531, 576
- Solar nebula,** 441
- Solar system**
 - asteroids, 426
 - comets, 428
 - galaxies, 436–437
 - inner planets, 422–423
 - meteors, 426–427
 - moon's phases, 416–417
 - outer planets, 424–425
 - planetary phases in, 418
- Solar tracking,** 114
- Solar wind,** 441, 519
- Solids,** 471
 - in atmosphere, 372
 - in solutions, 499
 - water, 470
- Solubility,** 492
- Solutes,** 498
- Solutions,** 498–499
- Solvents,** 498
- Sound energy,** 529
 - thunder, 532
- Sound waves,** 538–539
- South America, movement of,** 244
- Southern Hemisphere**
 - aurora australis, 519

- seasons in, 408–409
- South Pole**, 231
- Space**
Genesis spacecraft, 440–441
 microgravity of, 618
- Space Camp (Alabama)**, 588
- Specialized cells/tissues**, 40–41
- Species**, 91, 92
 endangered, 213, 216
 extinction of, 213
- Speed**, 597, 599–601
 of light, 548
- Sperm cells**, 50, 52
- Spider plants**, 136
- Spiders**, 98
- Spiral galaxies**, 436, 437
- Spirochetes**, 86
- Spores**, 84, 122
- Spring scales**, 20
- Spring tides**, 412
- Squid**, 357
- Stability**, 505
- Staghorn fern**, 122
- Stainless steel**, 499
- Stamens**, 130
- Stars**
 end of, 434–435
 formation of, 433
 lives of, 434
 shooting, 426
 types of, 432–433, 434, 435
- States of matter**, 470–471
 changes in, 472–473
 plasma, 474
- Static electricity**, 570
- Steel**, 193
- Stems**, 45
 underground, 136
- Stentor**, 33
- Stigma (flowers)**, 130, 133
- Stomach**, 42
 acid in, 516
 cells in, 40
- Stonehenge (England)**, 403
- Storms**
 blizzards, 394
 dust, 292
 hurricanes, 386, 392–393
 thunderstorms, 390–391, 532
 tornadoes, 391
 typhoons, 393
- Storm surges**, 392
- Stratigraphy**, 314
- Stratosphere**, 373
- Strawberries**, 134, 136
- Streak (minerals)**, 266
- Style (flowers)**, 130
- Subatomic particles**, 8, 453
- Sublimation**, 473
- Submarine, sunken**, 620–621
- Subsoil**, 291
- Succession**, 203
- Sugar (photosynthesis)**, 107, 109
- Sulfuric acid**, 516
- Summarizing (in reading)**, R26–27
- Sun**
 atmosphere and, 374
 eclipses, 410–411
 as energy source, 158
Genesis spacecraft mission to, 440–441
 in H-R diagram, 433
 light energy from, 542
 plasma in, 474
 seasons and, 408
 temperatures on, 420
 water cycle and, 338
- Sunflowers**, 115, 116
- Sunlight**
 in oceans, 354
 in photosynthesis, 107
 phototropism, 114
- Sunsets**, 549
- Supercontinent**, 244
- Supergiant stars**, 434, 435
- Supernova**, 434, 435
- Surface currents (oceans)**, 349
- Surface tension**, 608
- Surface waves**, 249
- Suspensions**, 500
- S waves**, 249
- Switches, electric**, 581
- Symbiosis**, 168–170
- Synthesis reactions**, 506
- Systems (human body)**, 46
 circulatory, 44, R6–7
 definition of, 44
 digestive, 40, 42, 44, R5
 endocrine, 45
 excretory, 45
 immune, R8–9
 integumentary, 44
 muscular, 44, R12–13
 nervous, R14–15
 reproductive, 45
 respiratory, 44, 45
 skeletal, 44, R10–11

T

- Tables**, R28
- Taiga**, 177
- Tallgrass prairie**, 216
- Tallgrass Prairie National Preserve (Kansas)**, 216
- Tamarin**, 83
- Tape measure, metric**, 18
- Tarantulas**, 152
- Teeth**, 44
- Telescopes**, 423
- Temperate deciduous forests**, 176–177
- Temperate grasslands**, 180
- Temperature**
 air masses and, 378, 380
 in atmosphere, 370
 change of altitude and, 172
 definition of, 562
 of oceans vs. land, 348
 scales for, 20, 563
 sun's heat and, 374
- Terminals, battery**, 580–581
- Theme park rides**, 648
- Thermal energy**, 529, 531, 562–563
 definition of, 562

heat and, 564–565. *See also*
Heat
insulation and, 566, 588
movement of, 563
Thermographs, 384, 540
Thermometers, 20, 562
Thermosphere, 373
Thigmotropism, 115
Third quarter moon, 417
Thomson, J. J., 454–455
Threads (screws), 644
Threatened species, 213
Thunderstorms, 390–391, 532
Ticks, 168
Tides, 202, 412
electricity generation from,
576
Time/space relationships, 10
dating rocks with fossils, 313
Tissues
in organs, 40
plant, 45, 108
in small intestine, 41
specialized, 41
Tongue, 42, 44
Tools
for data collection, 21
for measuring, 18–20
for weather forecasting, 388
Topaz, 269
Topsoil, 291, 292
Tornadoes, 391
Total eclipses, 411
Touch, plants sensitive to, 114,
115
Trachea, 44
Tracking devices, 552–553
Transform fault boundaries,
242, 243
Transit, 442
Translucent materials, 550
Transparent materials, 550
Transpiration, 107–109, 338,
339
Tree farming, 194
Tree ferns, 122

Trees
farming of, 194
as natural resource, 190
pollination of, 133
as renewable resource, 196
See also specific names, e.g.,
Ginkgo
Trenches, ocean, 347
Triceratops, 322
Trillium, 150
Trilobites
change over time in, 324
fossils of, 307, 314
Tropical air masses, 378
Tropical depressions, 392
Tropical forests, 154, 176, 214
Tropical grasslands, 180
Tropical rain forests, 148, 176,
177
Amazon, 138–139
destruction of, 219
Tropical storms, 392
Tropisms, 114–115
Troposphere, 373
Trough (waves), 536–537
Tsunamis, 251
Tubers, 136
Tube worms, 360
Tundra, 177
Turbines
hydroelectric plants, 574
wind, 576
Typhoons, 393

U

Ultraviolet light rays, 541
Umbra, 411
Unbalanced forces, 607
Universe, formation of, 438
Uplift, 235
Uranium, 462
Uranus, 424, 425
Using numbers, 10
layers of atmosphere, 371
modeling solar system, 421

V

Vacuoles, 34
Valleys, glaciers and formation
of, 234, 235
Variables, 12–13
Vascular plants, 108–109
Vascular tissue (plants), 82
Veins (plant), 45
Velez, Miguel, 296
Velocity, 599
acceleration and, 600–601
Vents, 253, 360
Venus, 418, 422, 442
Vertebrates, 83
Villi, 41
Vinegar, 515
Visible light, 547
Volcanoes
climate and, 384
at convergent boundaries, 243
eruption of, 253
formation, 252–253
Hawaiian, 254
lava, 275, 278, 285, 562
magma, 252–254, 274–275,
285
Mount Nyiragongo, 294–295
Mount St. Helens, 256–257
in oceans, 347
Volcanologists, 295
Volume, 488
tools for measuring, 18
Von Linné, Carl, 77, 78

W

Wafula, 294
Wanariset Forest Research
Station (Indonesia), 219
Waning moon, 417
Warm air masses, 379
Warm fronts, 380–381
Warm-water currents (oceans),
349
Watches, tracking, 552–553

Water

- cascades, 335
- changes of Earth's surface
 - from, 232, 233
- changes of state, 472–473
- as compound, 465
- cycle of, 338–339
- distilled, 515
- for drinking, 195, 340
- fresh, 340–341, 350
- from glaciers, 396–397
- in human body, 340
- hydroelectric power, 574
- irrigation, 397
- molecules in, 471
- as natural resource, 195
- potential energy of, 531
- preservation of, 342
- solutions in, 498
- states of, 470–471
- tides, 412
- tsunamis, 251
- See also* Oceans
- Water cycle**, 202, 338–339
 - energy from sun and, 542
 - fresh water in, 341
- Waterfalls**, 335
- Water slides**, 604
- Waterspouts**, 369
- Water vapor**, 470
 - in atmosphere, 372
 - molecules in, 471
 - in water cycle, 338–339
- Watts**, 581
- Wavelength**, 537
 - of light, 540, 547
- Waves**, 536–537
 - definition of, 536
 - of earthquake energy, 249, 536
 - electromagnetic, 540–541
 - energy in, 534
 - light, 540–541
 - mechanical, 536
 - ocean, energy from, 586–587
 - sound, 538–539

Waxing moon, 417**Weather**

- air masses, 378–379
- blizzards, 394
- climate and, 384
- clouds, 380, 381, 382
- definition of, 378
- forecasting, 388–389
- fronts, 380–381
- global wind patterns, 383
- hurricanes, 392–393
- thunderstorms, 390–391, 532
- tornadoes, 391
- Weather balloons**, 388, 389
- Weathering**, 232, 233
 - in soil formation, 290–291
- Weather maps**, 388, 389
- Weather satellites**, 388, 389
- Wedges**, 642–643
- Weight**, 618
- Welwitschia**, 125
- Wetlands**, 210, 215
- Whales**, 356
- Wheel-and-axles**, 631, 635
 - theme park rides, 648
- White dwarf stars**, 434, 435
- White-tailed deer**, 150
- Wide-range indicators**, 514
- Willamette River meteor (Oregon)**, 427
- Wind**
 - blizzards, 394
 - changes of Earth's surface
 - from, 232, 233
 - climate and, 384
 - electricity generation from, 576
 - global, 383
 - hurricanes, 392
 - ocean temperatures and, 348
 - pollination by, 133
 - solar, 441, 519
 - tornadoes, 391
- Wind tunnels**, 646

Wood

- houses made of, 193
- petrified, 305
- Wood beetles**, 150
- Woodpeckers**, 152
- Work**, 630–631
 - definitions of, 630
 - done by machines, 631
 - with inclined planes, 641
 - levers and, 633
- Work input**, 633
- Work output**, 633
- Wrasses**, 169
- Wright, Frank Lloyd**, 189
- Wright, Wilbur and Orville**, 646–647

X

- X rays**, 541
- Xylem**, 45, 108, 109

Y

- Years**, 407
- Yeast**, 84
- Yellowstone National Park**, 258, 336
- Yew**, 125
- York, Hunter**, 68
- Yosemite National Park**, 234

Z

- Zinc**, 463
- Zoologists**, 98