

Index

Note to the Reader: Throughout this index **boldfaced** page numbers indicate primary discussions of a topic. *Italicized* page numbers indicate illustrations.

-
- A**
- Absolute Transform feature, 78
 - Academy Flat aspect ratio, 20
 - Academy Standard aspect ratio, 20
 - Accuracy setting, **519**, 519
 - Active attribute, 544, 549
 - active rigid bodies
 - animating, **549–551**, 549–550
 - creating, **543–545**, 543–544
 - acts in narrative films, 25
 - Add Attribute window, 426, 426
 - Add Divisions to Face Options dialog box, 243, 243
 - Add Divisions tool, **129–130**, 129–130, 153
 - Add New Toon Outline option, 576
 - additive color, 17–18
 - aim constraints, **422**, 422
 - Aim Vector setting, 422
 - alien hands
 - fingers, **200–201**, 200–201
 - lattices for, **197–199**, 198–199
 - Alpha Channel (Mask) option, 480
 - alpha channels, 16, 479–480, 484, 485
 - Ambient Color attribute, **286**, 286
 - Ambient lights, **444**, 444
 - ambient occlusion
 - red wagon model, **536–540**, 537–539
 - rendering pass, **520–526**, 520–527
 - Ambient Shade settings, 444, 444
 - Anamorphic Ratio aspect ratio, 20
 - angles
 - camera shutter, 496
 - Spot lights, 446, 446
 - sun light, 459–460, 459
 - animation, **4**, **345**
 - axe throwing. *See* throwing axe
 - basic concepts, **26–29**, 27
 - bouncing ball. *See* bouncing ball catapult
 - catapult
 - deformers, **382–385**, 382–385
 - winch, **379–381**, 380–381
 - flying text, **372–375**, 373–376
 - through lattices, **201–202**, 202–203
 - lights, **471–472**, 471–472
 - particle effects, **562–570**, 563–570
 - pool table. *See* pool table
 - animation
 - relationships in
 - constraints, **420–424**, 421–423
 - set driven keys, **424–427**, 426–427
 - replacing objects in, **371–372**, 372
 - rigging. *See* rigging
 - rigid bodies, **549–551**, 549–550
 - skeletons. *See* skeletons
 - solar system. *See* solar system
 - animation
 - summary, 385–386, **435–436**
 - in work flow, **11**
 - Animation menu set, 102
 - Animation Preferences window, 351
 - Anisotropic Shader, **284**, 284
 - ankle joints, 388–389, 388, 395, 415–417
 - antagonists, 24
 - anti-aliasing
 - in Maya Software rendering method, 482
 - in mental ray rendering, **501–503**, 503
 - for shaders, 290
 - Anti-aliasing Contrast setting, **502**
 - anticipation
 - in animation, 28
 - in axe throwing, **359–360**, 361
 - Arc and Cone End Radius attribute, 448
 - Arc Angle option, 124
 - architectural modeling, **10**
 - Area lights, **446–447**, 446–447
 - areas in vector images, 14
 - art
 - description, **2**
 - suggested reading, 30
 - Artisan module, **191–193**, 192–193
 - aspect ratio, **20**, 223, 480, 492, 499
 - assembling scenes, 7–8
 - Assign Material to Selection option, 53, 290
 - Assign New Material option, 295
 - Attach to Motion Path dialog box, 369, 374, 374
 - attaching
 - NURBS surfaces, **178**, 178
 - skeleton geometry, **395**, 395–396, 406
 - attributes and Attribute Editor, 34, 72, 78
 - cameras, **491–495**, 491–495
 - creating, **426**
 - emitters, **557–558**, 557–558
 - keyframes for, 52
 - lifespan, **559**
 - lighting, **442–443**, 443
 - mental ray lighting, 457–458, 457
 - metal shaders, 291
 - nParticles, **559–561**, 559–561
 - Paint Effects, **573–574**
 - particles, **565–567**, 565–567
 - Ramp shader, **284–285**, 285
 - raytraced shadows, 452
 - rendering, **568–570**, 568–570
 - rigid bodies, **546**, **550–551**
 - shading and shaders, **285–289**, 286–288, **560–561**, 560–561
 - shadow maps, 451, 451
 - spheres, **91–93**, 92–93
 - texture nodes, 303, 303
 - windows for, 83
 - wood material, 293, 295–296, 296
 - wood texture, 293–294, 293
 - Auto Keyframe feature, 72
 - axe throwing, 360, 362
 - bouncing ball, 347
 - planets, **65–66**
 - Auto Load option, 501
 - Automatically Fit Bevel To Object option, 121
 - AVI movie format, **16**
 - axe model
 - deformers for, **195–197**, 195–197
 - edges, 355, 355
 - handles, **293–295**, 293–295, 355, 355
 - head, **290–293**, 291–292
 - metal spike, **295–298**, 295–298
 - textures, **289**
 - throwing. *See* throwing axe
 - axes, **21**, 22
 - axles for steam locomotive, **158**, 158–159

back lights, 26, **441**, 441

back wheels rigging, **433–434**, 433–434

background lights, 441

baking

- history, 409
- simulations, **551–553**, 552–553
- texture projections, **299–300**

balance, **23**

balls

- bouncing. *See* bouncing ball
- pool table animation, **546–550**, 547–548
- relationship with cones, 424, 424

banding, color, 15

Batch Render Animation dialog box, 496, 496

batch rendering

- process, **496–497**, 496
- with render layers, **515–516**, 515–516
- wine bottle, **500**

bend deformers

- catapult animation, **382–384**, 382–385
- working with, **193–194**, 193–195

bevel surfaces, **170–171**, 170

Bevel Plus surfaces, 171

Bevel tool, **121**, 121–122, 171

bevels, red wagon model

- railings, **265–267**, 265–268
- side panels, 235, 235

Bezier curves, 112, 113

Bezier splines, 364–365

Bind Skin option, 408

binding skeletons, **406–410**, 406, 408

- rigid binds, **409–412**, 409–412
- smooth binds, **412–415**, 413–414

bitmapped images, **13**, 14

bitmapped textures, 299

Blinn shaders, **283**, 283

- in projections, 301
- red wagon model, 309, 309

Blinn surfaces, 283

block man

- attaching elements to, **395**, 395–396
- Forward Kinematics, **390**, 390
- leg rigging, **415–417**, 416–417
- skeletons, **391–394**, 393–394
- walk cycle
 - Forward Kinematics, **396–402**, 397–401
 - Inverse Kinematics, **417–419**, 418–419

blocking, 347

B blowing grass and flowers, **571–573**, 571–572

blue color, 18–19

blur

- motion, **495–496**
- reflections, **535–536**, 536

Blur by Frame attribute, 495

Blur Length attribute, 495

body, red wagon model, **249**, 250

- bullnose, **252–254**, 253–254
- decals, **321**, 321
- floor, **250–251**, 250–252
- screws, **278**, 278–279, **342**

boiler engine, **138–139**, 139

caps

- end, **182–186**, 183–186
- front, **140–143**, 140–142
- topside, 151, 151

chimneys, **148–149**, 148–149

- details, **141–143**, 141–142
- finishing, **148–149**, 148–149
- undercarriage, **143–148**, 143–147

bolts

- boiler cap, 141–142, 141
- red wagon handlebars, **255–257**, 255–257

bones

- creating, 392
- in skeleton hierarchy, 388–389, 388

Booleans, **238–243**, 238–243

bottle rendering, **497–500**, 498–500

bounce in mental ray, 483

Bounciness attribute, 546, 550

bouncing ball

- animating, **347–348**
- creating, **346**, 346
- Graph Editor for, **348–350**, 349–351
- playing back, **351**
- rigid bodies for, **543–544**, 543
- squash and stretch in, **353**, 353
- timing for, **352**, 353

boundary surfaces, **171**, 172

Bowling Lane scene, 551

box modeling, 117

Break Connection option, 308

Break Tangents icon, 365

brightness in HSV channels, 19

Brush Profile attribute, 573

Brush Width attribute, 573

Bulge texture, 305

bullnose, red wagon model

- creating, **252–254**, 253–254
- texturing, **341**, 342

Bump Maps, 282, **286**, 287

bumps for red wagon wheels, **317–319**, 317–320

buttons, mouse, 72

By Frame attribute, 478

C cabin in steam locomotive, **152–154**, 152–154

caching nParticles, **561–562**

cages, polygon, 206

Camera, Aim, and Up cameras, 490

Camera and Aim cameras, 490

cameras, **489**

- attributes, **491–495**, 491–495
- creating, **489**
- motion blur, **495–496**
- in rendering, **479–480**, 479, **498–500**, 498–500
- types, **490**, 490

caps in steam locomotive

- end, **182–186**, 183–186
- front, **140–143**, 140–142
- topside, 151, 151

Cartesian coordinate system, 21

case-sensitivity, 35, 105

Casts Shadows option, 453, 464–465

catapult animation

- deformers for, **382–385**, 382–385
- winch in, **379–381**, 380–381

caustics, 455, 483

CCIR 601/Quantel NTSC resolution, 480

center of balance, 356, 356

Center of Mass attribute, 551

Center Pivot option, 157

Center zone, hotbox, 100, 100

CGI (Computer Graphics Industry), 2

chains, IK, **419–420**, 420

Channel Box, 34, 72, **78–82**, 81, 92, 471

channels in rendering, **479–480**, 480

character modeling, **10**

Character Set menu, 34, 72, 82

Checker texture, 305

child nodes, **59–60**, 60, 66, 68

chimneys for steam locomotive, **148–149**, 148–149

Chord Height Ratio option, 175

Circle option, 168, 169

cleaning up red wagon model, **248–249**, 249

clipping planes, **492**

Closest Distance option, 408

Closest Joint option, 407

Closest On Hierarchy option, 408

Closest Point option, 407

Cloth texture, 305

Cloud particle type, 560

- attributes, 561, 561

- emitting, 556–557, 557–558, 562–564, 563–564
 - workflow, 568–570, 568–570
 - clusters in binding, 407
 - CMYK (Cyan, Magenta, Yellow, and Black) color space, 18–19
 - collisions, 542–546, 549–550, 555, 567, 567
 - color, 17–18
 - additive and subtractive, 17–18
 - CMYK, 18–19
 - customizing, 106, 106
 - defined, 18–19
 - in design, 24
 - joints, 413
 - for layers, 81
 - in ramp textures, 285
 - red wagon wheels, 311–315, 312–315
 - rendering, 503
 - shaders, 51
 - toon shading, 576–577
 - volumetric lighting, 462
 - Color attribute
 - lighting, 443
 - nParticles, 561, 561
 - shaders, 285
 - Color Balance attributes, 303
 - color banding, 15
 - color channels, 16
 - Color Chooser window, 51, 51, 465, 568
 - color depth, 15–16
 - Color Joints option, 407
 - Color Range attribute, 447
 - Color Settings window, 106, 106
 - color wheels, 18
 - Color1 and Color2 attributes, 573
 - Combine tool, 132–135, 132–134
 - combining NURBS techniques, 171–172
 - Command line, 83–84, 83, 99
 - Common tab for rendering, 477
 - complementary colors, 24
 - complex objects. *See* steam locomotive
 - Component Mode icon, 76
 - compositing
 - Ambient Occlusion results, 526, 526–527
 - in postproduction, 7
 - composition in design, 23
 - computer graphics (CG), 2–3, 13
 - 3D coordinate space and axes, 21, 22
 - color, 17–19
 - image output, 15–17
 - raster images, 13, 14
 - resolution, aspect ratio, and frame rate, 19–21
 - suggested reading, 30
 - vector images, 14–15, 15
 - Computer Graphics Industry (CGI), 2
 - conceptuals, 6
 - Cone Angle setting, 446
 - cones
 - creating, 301, 301
 - relationship with balls, 424, 424
 - Connection Editor, 99–100, 99, 428–429, 429
 - connections
 - attribute, 99–100, 99
 - caps to cylinder, 185
 - input and output, 77
 - NURBS curves, 164
 - wheel control, 428–429, 429
 - Constant attribute, 559
 - constraints, animation, 420–424, 421–423
 - construction history, 77
 - contrast, 24, 24
 - control vertices (CVs)
 - attaching to skeletons, 406–407
 - in NURBS, 112–113, 113
 - snapping to, 77
 - Controls attribute, 491
 - converting
 - NURBS to polygons, 176, 177
 - polygons to subdivision surfaces, 206–208, 206–208, 213–215
 - subdivision surfaces to polygons, 216, 216
 - UVs to faces, 324, 324
 - cool colors, 18
 - coordinates
 - 3D, 21, 22
 - UV, 322–337, 323–337
 - copying
 - polygon faces, 135
 - UVs, 331–332
 - core concepts, 13
 - animation, 26–29, 27
 - computer graphics. *See* computer graphics (CG)
 - design, 22–24
 - film, 25–26
 - Cosine Power attribute, 288
 - Coverage setting, 304
 - cowcatcher, 146, 147
 - Create Active Rigid Body option, 543, 548
 - Create/Bins panel, 96–97
 - Create Deformers option, 197–198
 - Create Emitter option, 556, 562
 - Create Flexor option, 410
 - Create menu, 74
 - Create Motion Trail option, 367
 - Create New Cache option, 562
 - Create Passive Collider option, 567
 - Create Passive Rigid Body option, 543, 548
 - Create PSD Network option, 306
 - creation nodes, 58
 - cubes
 - for axe, 354–355
 - subdividing, 153
 - for targets, 356
 - current frame, 82
 - current time indicator, 82
 - curvature with bend deformers, 194, 382–384, 382–385
 - Curve Degree setting, 148
 - curves
 - for axe throwing, 360–363, 361
 - for flying text, 372–375, 373–376
 - in Graph Editor, 348–350, 349–351, 553–555, 553–554
 - NURBS. *See* NURBS (Non-Uniform Rational B-Splines)
 - modeling and surfaces
 - in pool table animation, 553–555, 553–554
 - profile, 258–264, 259–264
 - projecting, 177–178
 - customizing
 - interface, 102–107, 103–106
 - shelf, 80, 104, 104
 - Cut Faces tool, 135, 135
 - cuts in shots, 25
 - CV Curve tool, 114, 148, 369
 - CVs (control vertices)
 - attaching to skeletons, 406–407
 - in NURBS, 112–113, 113
 - red wagon wheels, 258–264, 259–264
 - snapping to, 77
 - Cyan, Magenta, Yellow, and Black (CMYK) color space, 18–19
 - cylinders
 - axe, 354–355
 - bend deformers for, 193–194, 193–195
 - boiler engine, 138–139, 139
 - pump, 180–181, 180–182
 - targets, 356
-
- D
- DAG nodes, 58
 - dailies, 478
 - Damping attribute, 546
 - decals, 321, 321

Decay Rate attribute
 Point lights, 445, 445
 Spot lights, 445

decays, bounce, 351, 352

Default Color attribute, 304

deformations, 505

deformers, 193
 axe model, 195–197, 195–197
 bend, 193–194, 193–195
 catapult animation, 382–385, 382–385
 flame, 195–196, 196
 history for, 197
 lattices. *See* lattices
 wave, 423

Delete Cache option, 562

Delete Unused Notes option, 297, 300

denormalizing views, 361

Density attribute
 nParticles, 570
 volumetric lights, 462

depth
 color, 15–16
 in space, 21

Depth Channel (Z Depth) setting, 480

Depth Map shadows, 450

Descartes, Rene, 21

design concepts, 22
 balance and symmetry, 23, 23
 color, 24
 contrast, 24, 24
 form, space, and composition, 22–23
 narrative films, 24
 suggested reading, 30

Detach Skin option, 408–409

detaching
 NURBS surfaces, 178, 179
 skeletons, 408

details
 boiler engine, 141–143, 141–142
 characters, 12
 environment, 12
 in models, 110–111, 110
 poly meshes, 128, 129
 red wagon model, 279–280, 279–280
 teakettle model, 217

Device Aspect Ratio attribute, 480

Dice scene, 551

Difference operator, 238

Diffuse attribute, 287, 287

diffuse lighting, 443, 443

diffusion, 283, 283

Direction attributes, 562–563

Directional emitters, 557, 557, 562

Directional lights, 444, 445, 459–460, 459

Disable Implicit Control option, 552

disconnecting textures, 308

disk space for projects, 41–42

Display Alpha Channel option, 484, 485

Display Film Gate attribute, 493, 499

Display Level options, 207–208

Display menu, 74

Display Options for cameras, 492–493, 499

Display Real Size option, 485, 485

Display Resolution attribute, 493

Display RGB Channels option, 484, 485

Display settings, 103

dome light, 517, 517

donuts for rings, 47–48

drive mechanism, steam locomotive, 159, 159

Dropoff setting, 446

Dropoff Rate setting, 408

Duplicate Face tool, 135

Duplicate Special option, 139

Dynamic Friction setting, 546

Dynamic Relationships window, 544–545, 544

dynamics and dynamics engine, 541
 baking out simulations, 551–553, 552–553
 overview, 542
 particles. *See* particles and particle dynamics
 pool table. *See* pool table animation
 rigid bodies, 543–545, 543–544
 summary, 577–578

Dynamics menu set, 102

effects
 lighting, 461
 lens flare, 462–464, 463
 shader glows, 464–465, 464–465
 volumetric lighting, 462, 462

Paint Effects, 541
 attributes, 573–574
 working with, 571–573, 571–572
 texture nodes, 303

Effects attributes, 303

8-bit image files, 16

Emit Diffuse option, 443

Emit Specular option, 443

emitters, 555–557, 556–557
 attributes, 557–558, 557–558
 emitting process, 562–564, 563–564

Enable Default Light option, 518

end caps, 182–186, 183–186

end effectors, 415

End Frame attribute, 478

End Sweep attribute, 517

engines, rendering, 476–477
 Maya Hardware, 482–483, 483
 Maya Software, 481–482, 482
 Maya Vector, 484, 484
 mental ray for Maya, 483

engines, steam locomotive. *See* boiler engine

Env Chrome texture, 291–292

Envelope attribute, 383

Environment section for cameras, 493–495

environment textures, 307

environmental modeling, 10

Erase option, 193

exaggerating object weight, 28

.ext format, 477

extensions, filename, 477

Extract tool, 136

Extrude option, 119–120

extruded faces
 polygons, 119–120, 119
 red wagon body, 251, 251, 278, 278
 subdivision surfaces, 210–211

extruded surfaces, 166, 167

extrusion tools, 119–120, 119

E

Earth
 animating, 63, 64
 grouping with moon, 64–65

ease-in, 28, 350, 350

ease-out, 28, 349, 350

East zone, hotbox, 100, 100

Edge Split tool, 138, 139

edges
 axe, 355, 355
 polygon, 111, 111
 red wagon panel, 247–248, 247–248

Edit Layer dialog box, 81, 81

Edit menu, 73–74

Edit Rigid Skin option, 410

editing, 7–8
 NURBS surfaces, 177
 rigid binds, 410–412, 410–412
 smooth binds, 413–415, 413–414
 vector programs, 15

F

faces
 converting UVs to, 324, 324
 extruded
 polygons, 119–120, 119
 red wagon body, 251, 251, 278, 278
 subdivision surfaces, 210–211
 polygon, 111, 111, 121, 121

Far Clip Plane attribute, 492
 FCheck frame viewer, 500, 500
 feedback history
 command, 83
 Script Editor, 99
 FG (Final Gather) process
 image-based lighting, 456
 process, 517–520, 517–519
 fields of blowing grass and flowers,
 571–573, 571–572
 fields with dynamic bodies, 542
 file formats, 16–17
 File menu, 73–74
 file name prefix setting, 477
 file nodes for textures, 306–308
 filenames, 477
 fill light, 26, 441
 Fill Options option, 484
 Film Back attribute, 492
 film concepts, 25
 lighting, 26
 production planning, 25
 suggested reading, 30
 film gate, 499
 Film Gate attribute, 492
 filtering for mental ray rendering, 502
 Final Gather (FG)
 image-based lighting, 456
 process, 517–520, 517–519
 fingers
 creating, 123–127, 123–127
 lattices for, 200–201, 200–201
 Fit Resolution Gate attribute, 492
 FK (Forward Kinematics),
 388–389, 389
 for block man, 390, 390
 walk cycle, 396–402, 397–401
 flame deformers, 195–196, 196
 flexors, 409–412, 410–412
 floating menus, 74
 floor, red wagon model
 creating, 250–251, 250–252
 texturing, 337–338, 338
 Flow Path Object option, 375
 flowers and grass, 571–573, 571–572
 fluid dynamics, 542
 flying text, 372–375, 373–376
 Focal Length attribute, 491, 491
 Fog Intensity setting, 462
 Fog Spread setting, 462, 462
 Foley sound, 8
 Follow feature, 369
 follow-through
 animation, 28
 axe throwing, 363–366, 364–366
 form in design, 22

Forward Kinematics (FK),
 388–389, 389
 for block man, 390, 390
 walk cycle, 396–402, 397–401
 fps (frames per second), 20
 Fractal texture, 305
 Fractional Tolerance option
 NURBS from polygons, 176
 polygons from NURBS
 surfaces, 175
 Frame All option, 88
 Frame/Animation Ext attribute,
 477–478
 frame numbers
 displaying, 367–368
 in filenames, 477
 Frame Padding attribute, 479, 479
 frame ranges in rendering,
 478–479, 479
 frame rate, 20
 Frame Selection option, 88
 Frame setting, 304
 frames, 4, 26, 27
 frames per second (fps), 20
 framing, 25
 framing in thirds, 23, 23
 Freeform Layout option, 390, 391
 freezing transformations, 180–181,
 180, 346, 367
 friction of rigid bodies, 546
 Front Axis setting, 374
 front caps, 140–143, 140–142

G
 Game of Marbles scene, 551
 General tab in Multilister, 95
 General Tessellation Method option, 175
 geometry, 10
 attaching, 395, 395–396, 406
 constraints, 423, 423
 Get Brush option, 571–572
 ghosting, 370
 Global Illumination (GI)
 with Ambient Occlusion, 521
 lighting with, 455–456
 with mental ray, 483
 Glow Color attribute, 463
 Glow Intensity attribute
 lens flare, 463
 shaders, 287, 288, 465
 Glow Radial Noise attribute
 lens flare, 463, 463
 shader glows, 465
 Glow Type attribute, 463
 glowing effect, 464–465, 464–465
 Go to Bind Pose option, 408

gradients
 ramp textures, 284–285, 304, 304
 red wagon wheels, 311–315
 Graph Editor, 97–98, 97
 animation curves, 553–555,
 553–554
 axe throwing, 360–363, 361
 bouncing ball, 348–353, 349–353
 walk cycle, 400–401, 401
 graphics. *See* computer graphics (CG)
 grass and flowers, 571–573, 571–572
 grass brush, 571
 gravity
 in animation, 28, 548
 in dynamics, 544–545
 grayscale channel, 480
 grayscale images, 15
 green color, 18
 grid display, 86
 grid snaps, 45–46
 Grid texture, 305
 gross animation, 347
 grouping
 Earth and moon, 64–65
 Mercury, 57
 objects, 67–68, 93–94, 94
 Growth attribute, 573

H

hair, 542
 Hair Tube shader, 283
 Halo Type attribute, 463
 handlebars, red wagon model
 bolts, 255–257, 255–257
 creating, 254, 254
 holes, 238–239, 239–240, 242–243,
 242–243
 shading, 342
 handles
 axe
 creating, 293–295, 293–295
 head on, 355, 355
 tangents, 365, 365
 teakettle, 210–211, 210, 214, 214
 hands, 402, 402
 block man, 390
 fingers, 200–201, 200–201
 joints for, 403–405, 404–405
 lattices for, 197–199, 198–199
 polygons for, 122–128, 122–128
 rigging, 403–405, 404–406
 set driven keys for, 425–427,
 426–427
 hardware particles, 560
 HDRI (High Dynamic Range
 Imagery), 16, 528–529, 528, 535

- HDTV (High Definition TV)
 - resolution, 20
- heads, axe, **290–293**, 291–292
- height
 - in aspect ratio, 20
 - in resolution, 480
 - in space, 21
- Height Ratio attribute, 48
- Height setting in rendering setup, 480
- Help line, 83–84, 83
- Help menu, 74
- hierarchies
 - objects, **59–60**, 60
 - Outliner, **66–68**, 66–67
 - skeletons, **388–389**, 388
- hierarchy mode
 - description, 76
 - for Earth and moon, 64
- High Bound attribute, 194, 195, 383
- High Color images, 15
- High Definition TV (HDTV)
 - resolution, 20
- High Dynamic Range Imagery (HDR1), **16**, **528–529**, 528, **535**
- Highlight Size attribute, 289
- highlights, lighting for, 438
- hip joints, 388–389, 388
- history
 - baking, 409
 - for deformers, 197
 - NURBS surfaces, **173–174**, 174
- holes in red wagon panels, **238–239**, 239–240, **242–243**, 242–243
- hot keys, Graph Editor, 360
- hotbox, **100–102**, 100–102
- Hotkey Editor, 104–105, 105
- hotkeys, customizing, **104–105**, 105
- HSV (hue, saturation, and value)
 - channels, 19
- HSV Color Noise attributes, 304
- hubcaps, 262–263, 262
- Hue/Sat/Value Rand attribute, 573
- hulls, CVs, 112
- humpback name style, 44
- Hypergraph, **94**, 94
 - freeform layout, 390, 391
 - object hierarchy, 60, 60
- Hypershade and Hypershade window, **95**, **96–97**, 282
 - importing photos, 224, 224
 - vs. Multilister, **292**
 - for shaders, 290, 291
 - for solar system animation, 50–53, 50, 53
 - UVs, **329–330**, 329
- IBL (image-based lighting), **456**, **532–535**, 532–535
- IFF (Image File Format) format, 16, 478, 480
- IK (Inverse Kinematics), 388–389, **415**
 - rigging legs, **415–417**, 416–417
 - walk cycle, **417–419**, 418–419
- IK Handle Size option, 416
- IK handles, 389, 389
- IK solvers, 389
- IK Spline Handle tool, 419
- Illuminates by Default option, 443
- illumination. *See* lighting
- image-based lighting (IBL), **456**, **532–535**, 532–535
- image channels, **479–480**, 479
- Image File Format (IFF) format, 16, 478, 480
- image mattes, **289**, 479
- image planes
 - cameras, **493–494**, 494
 - sequence, **495**, 495
- images
 - importing as textures, **305–306**, 305
 - output, 15
 - color, **17–18**
 - color channels, **16**
 - color depth, **15–16**
 - formats, **16–17**, **477–480**
 - movie files, **16**
 - reference planes for, **222–223**, 223
 - in rendering, **477–480**, 479, 486
- Images folder, 40
- importing
 - image files as textures, **305–306**, 305
 - image planes, 494–495, 494–495
- Impulse Position attribute, 551
- in-between frames, 26
- Incandescence attributes
 - nParticles, 561, 561
 - Paint Effects, 573
 - shaders, **286**, 286
- Incremental Save feature, **46–47**
- indirect lighting, 456, 458, 518–519, 519
- infinity of curves, 350
- Information Readout, 485, 485
- inherited nodes, 68
- Initial Spin attribute, 551
- Initial Velocity attribute, 550
- input connections, 77
- input line operations, 78
- Insert Edge Loop tool, **130**, 131, 138, 154, 212, 212
- Insert Keys tool, 370
- inserting isoparms, **179**, 179
- Intensity attribute, 443
- intents, 5
- Interactive Creation feature, 43
- Interactive Photorealistic Renderer (IPR), 294–295, **486–487**, 486
- interface, **34**, 71
 - Attribute Editor, **91–93**, 92–93
 - Connection Editor, **99–100**, 99
 - customizing, **102–107**, 103–106
 - Graph Editor, **97–98**, 97
 - hotbox, **100–102**, 100–102
 - Hypergraph, **94**, 94
 - Hypershade, **95**, **96–97**
 - manipulators, **89–91**, 89–91
 - marking menus, **101**
 - menu sets, **102**
 - Multilister, **95–96**, 95
 - navigating, 72
 - objects, 60
 - Outliner, **93–94**, 94
 - perspective/orthographic windows, **84–88**, 84, 87
 - screen components. *See* screen components
 - Script Editor, **98–99**, 98
 - summary, 107
- interpenetration, 202, 548
- interpolation
 - for ramp texture, 296, 304
 - in timing, 352
- Interpolation setting, 296, 304
- Intersection operator, 238
- Inverse Kinematics (IK), 388–389, **415**
 - rigging legs, **415–417**, 416–417
 - walk cycle, **417–419**, 418–419
- IPR (Interactive Photorealistic Renderer), 294–295, **486–487**, 486
- isoparms
 - for end caps, 182–186, 183–186
 - inserting, **179**, 179
 - in lofting, 172, 173
 - NURBS surfaces, 112, 113, 178–179
 - selecting, 179
 - spans, 116
- Jitter setting, 502
- joint clusters, 407
- Joint Photographic Experts Groups (JPEG) format, 16, 478
- Joint tool, 392

joints

- attaching, **395**, 395–396
- in binding, **406–410**, 406, 408
- bones between, 392
- for hands, 403–405, 404–405
- keyframes for, 397
- moving, 405, 405
- rotating, 389, 389
- for skeletons, 388–389, 388–389

JPEG (Joint Photographic Experts Group) format, 16, 478

knuckles

- alien, 200, 201
- creating, **126–127**
- flexors for, 410–412, 410–412

Lambert shaders

- creating, 224–226
- diffusion with, **283**, 283
- for solar system animation, 50

lattices, **197**

- animation through, **201–202**, 202–203

- binds, 410–411
- fingers, **200–201**, 200–201
- flying text, **375**, 375–376
- hands, **197–199**, 198–199
- red wagon model railings, **268–270**, 269–270
- subdivision surfaces, 211, 211
- summary, 217

laws of motion, **29**

Layer Editor, 34, 72, **78–82**, 81, 227, 227–228

Layered shader, **284**, 284, 295–298, 295

layers

- creating, 81
- render, **508**
 - batch rendering for, **515–516**, 515–516
 - shadow passes for, **513–514**, 513–515
 - still life, **508–511**, 509–511
 - testing, **511**, 511–512

learning to see, **438**

legs

- moving. *See* kinematics
 - rigging, **415–417**, 416–417
- lemon, rendering, **508–509**, 509–510
- batch rendering for, **515–516**, 515–516
 - shadow passes for, **513–514**, 513–515
 - testing, **511**, 511–512

Length Min/Max attribute, 573

lens flare, **462–464**, 463

levels of detail, **86–87**

lids, teakettle, 209–210, 213, 213

Lifespan Mode attribute, 565

lifespan of nParticles, **559**, 559

Lifespan Random attribute, 559

LifespanPP Only attribute, 559

Light Fog attribute, 462

light glow effect, **462–464**, 463

Light Radius setting, 454

Light Shape attribute, 447

lightbox for steam locomotive, 150, 150

Lighted mode, 88

lightFog node, 462

lighting, 9, **437**

animating, **471–472**, 471–472

attributes, **442–443**, 443

concepts, **438**

effects, **461**

lens flare, **462–464**, 463

shader glows, **464–465**, 464–465

volumetric lighting, **462**, 462

film, **26**

Final Gather, 518

learning to see for, **438**

light types, **443–448**, 444–447

linking, **448–449**, 448–449

mental ray, 455, 455–456

global illumination, **455–456**

image-based, **456**, 532–535, 532–535

physical sun and sky, **457–461**, 457–461

need for, **438–439**, 438–439

practical, **442**

practice for, **470**

red wagon model, **466–469**, 466–470

in shading, 283

shadows, 438, **449–454**, 450–454

summary, **473**

three-point, 26, **439–442**, 440–441

in work flow, 11–12

linking light, **448–449**, 448–449

lip-synch, 8

Live Forever attribute, 559

living room scene, **520–526**, 520–527

Loaded option for mental ray

rendering, 501

loading images, 486

Local Axis

axe throwing, 359

rotating, 21

Local Translate attribute, 123, 126

locking cameras, 499–500

locomotive. *See* steam locomotive

lofted surfaces, connecting, **171–172**, 173

lofting method

connecting caps to cylinder, 186

NURBS, **164–165**, 164–165

logos, flying, **372–375**, 373–376

Look at Selection option, 88

Low Bound attribute, 194, 383

low-count poly models, 112

K

Keep Faces Together option, 156, 210, 210, 212

Keep Image option, 486

Keep Image Width/Height Ratio option, 324

Keep Unbaked Keys option, 552

kettle model

base polygon model, **209–212**, 209–213

converting polygons to subdivision surfaces, **213–215**, 213–215

converting subdivision surfaces to polygons, **216**, 216

details for, **217**

key lights, 26, **440–441**, 440

Key Selected option, 471

keyboard shortcuts

capital letters with, 88

customizing, **104–105**, 105

overview, **36**

for viewing, **85**

keyframes, **26**, 27, 81, 347

for attributes, **52**

for axe throwing, **357–366**, 364–366

in bouncing ball animation. *See*

bouncing ball

for joints, 397

in pool table animation, 553

for rigid bodies, 549

setting, **52**

for timing, 352

for walk cycle, **397–402**, 397–401

keys, moving, 351, 352–354

kinematics, **388**

FK, **388–389**

for block man, **390**, 390

walk cycle, **396–402**, 397–401

IK, 389, **415**

rigging legs, **415–417**, 416–417

walk cycle, **417–419**, 418–419

knee joints

rigging, 417

skeletons, 388–389, 388

-
- Macintosh keys, 36, 85
- main menu bar, 34, 55, 55, 73–74
- manipulators, 89–91, 89–91
- for lights, 472, 472
 - pivot point, 64, 64
 - for projections, 302, 302
- maps and mapping
- Bump, 282, 286, 287
 - reference planes, 224–228, 224–228
 - reflection, 481
 - shadow, 450–454, 451–454
 - texturing and textures, 282
 - UV, 300–301
- marking menus, 100–101, 100
- masks, selection, 75–76
- mass
- in animation, 28
 - of rigid bodies, 546
- Mass attribute, 546
- match-moving, 495
- material nodes, 282, 290, 291
- materials
- red wagon wheels, 316, 316
 - shaders, 290, 291
 - solar system animation, 53
- Matte Opacity Mode and slider, 288
- matte paintings, 10
- mattes, 289, 479
- Max Distance attribute, 564
- Max Influences setting, 408
- Max Sample Level setting, 502
- Maya Embedded Language (MEL), 83, 98–99, 98, 104
- Maya Hardware rendering method, 482–483, 483
- Maya Image File Format (IFF) format, 16, 478, 480
- Maya Software rendering method, 481–482, 482
- Maya Vector tab, 484, 484
- MEL (Maya Embedded Language), 83, 98–99, 98, 104
- memory caching of particles, 561
- mental ray rendering, 483
- ambient occlusion, 536–540, 537–539
 - attributes, 289
 - Final Gather, 517–520, 517–519
 - image-based, 456, 532–535, 532–535
 - lighting, 455–456, 455–456
 - physical sun and sky, 457–461, 457–461
 - settings, 501–504, 501, 503–504
- Menu sets, 55, 55
-
- M**
- menus, 73–74
- hot box for, 100–102, 100
 - menu sets, 102
- Mercury
- creating, 44–45, 45
 - grouping, 57
 - rotation of, 56–57
- Merge tool, 132–135, 132–134
- meshes, 238–239, 239–240
- metal axe head, 290–293, 291–292
- metal shaders
- creating, 291
 - red wagon model, 342–343, 343
- metal spike, 295–298, 295–298
- Min and Max Distance setting for emitters, 558, 558
- Min Distance attribute, 564
- Min Sample Level setting, 502
- Mirror U setting, 304
- Mirror V setting, 304
- models, 9–11
- complex objects. *See* steam locomotive
 - with NURBS. *See* NURBS (Non-Uniform Rational B-Splines)
 - modeling and surfaces
 - planning, 110–111, 110
 - with polygons. *See* polygons
- Modify menu, 74
- momentum
- axe throwing, 366
 - description, 29
- moons
- creating, 49, 49
 - Earth, 63–65, 64
- motion
- animation. *See* animation
 - laws of, 29
 - simulating. *See* dynamics and dynamics engine
 - in vector programs, 14
- motion blur, 495–496
- motion studies, 357–358
- motion trails, 367–368, 367–368, 374, 374
- Mountain texture, 305
- mouse controls, 35–36, 72
- Move tool
- for hands, 405
 - working with, 89, 89
- Move Pivot tool, 405
- movie files, 16
- moving
- joints, 405, 405
 - keys, 351, 352–354
 - objects, 89–90, 89
 - rigid bodies, 545
- multi-pixel filtering, 502
- Multilister, 95–96, 95, 292
- multiple versions, saving, 46–47
- music, 8
-
- N**
- names
- layers, 81
 - nodes, 51
 - objects, 41, 44, 78, 94
- narrative films, 24–25
- National Television Standards Committee (NTSC) resolutions, 19, 480
- navigating, 72
- Near Clip Plane attribute, 492
- negative space, 22
- nested object hierarchy, 59
- New Project window, 40–41, 40
- New Scene option, 42, 75
- Newton, Isaac, 29
- nodes
- inherited, 68
 - objects, 58–59
 - renaming, 51
 - shader, 282
 - textures, 303–308, 303–308
- Noise attribute, 305
- Noise Frequency attribute, 305
- Noise texture, 305
- Non-Uniform Rational B-Splines. *See* NURBS (Non-Uniform Rational B-Splines) modeling and surfaces
- normal constraints, 423, 423
- normalized skin weights, 414
- normalizing views, 361, 361
- North zone, hotbox, 100, 100
- notches, 275, 275
- nParticles, 555–556
- attributes, 559–561, 559–561, 565–567, 565–567
 - caching, 561–562
 - emitting, 556–558, 556–557, 562–564, 563–564
- NTSC (National Television Standards Committee) resolutions, 19, 480
- null nodes, 68
- Number of Samples setting, 483, 502
- Number U setting, 169
- Number V setting, 169
- NURBS (Non-Uniform Rational B-Splines) modeling and surfaces, 113–115, 113–114, 164
- Artisan module for, 191–193, 192–193
 - attaching, 178, 178

for axes. *See* axe model
 bevel, **170–171**, 170
 boundary, **171**, 172
 combining techniques for, **171–172**
 cones, **301**, 301
 converting to polygons, **176**, 177
 curve projections on, **177–178**
 detaching, **178**, 179
 editing, **177**
 for end caps, **182–186**, 183–186
 extruded, **166**, 167
 history, **173–174**, 174
 isoparms, 112, 113, 178, 179
 lofting method, **164–165**, 164–165
 objects, 86, 87
 patch modeling, **180–191**, 180–182
 planar, **167–169**, 168–170
 for polygons, **175–176**
 pump, **180–181**, 180–182
 revolved, **165**, 165–166
 spheres
 creating, **302**, 302
 lattices for, **201–202**, 202–203
 stitching and tangency, **186–191**,
 187–191
 tools for, 79
 trimming and untrimming, **178**

O

Object Mode icon, 76
 objects, **37**, 37, **57–58**
 Boolean, **238–239**, 239–240
 grouping, **67–68**, **93–94**, 94
 names, **41**, 44
 nodes, **58–59**
 parents and children, **59–60**, 60
 replacing, **371–372**, 372
 occlusion, ambient
 red wagon model, **536–540**,
 537–539
 rendering pass, **520–526**, 520–527
 Offset Edge Loop tool, **131–132**, 131
 Offset values
 aim constraints, 422
 orient constraints, 421
 Omni emitters, 557, 557
 opacity
 in Artisan, 192
 matte, 288
 UV layouts, 328–329, 328
 Opacity Scale attribute, 561, 561,
 568, 568
 Open Image option, 486
 Open Render Settings window,
 484, 485
 Open Scene icon, 75

OpticalFX node, 463
 option boxes, 74
 organic characters, 10
 orient constraints, **421**, 421
 origins
 3D coordinates, 21
 UV coordinates, 321
 orthographic windows, **84–88**, 84, 87
 Out Color attribute, 523
 Outliner, **93**
 objects in, 60, 60, **93–94**, 94
 for solar system animation, **66–68**,
 66–67
 outlines for toon shading, 576–577, 577
 output connections, 77
 outputting solar system animation,
 68–70, 69–70
 overlighting, 438, 438
 Overscan setting, **492–493**

P

padding frames, 479, 479
 Paint Effects, **541**
 attributes, **573–574**
 toon shading, **574–577**, 575–577
 working with, **571–573**, 571–572
 Paint Effects to Polygons option, 574
 Paint Skin Weights tool, 413–414
 painting skin weights, **412–415**,
 413–414
 PAL (Phase Alternation Line)
 resolution, 20
 panel layouts, 84, 86
 panels, red wagon model
 rounding edges, **247–248**, 247–248
 shaping, **228–238**, 228–237, **244–**
 246, 244–246
 UV coordinates, **322–337**, 323–337
 panels, screen, 34, 72
 parametric modeling, 48
 parent constraints, 424
 parent nodes, **59–60**, 60, 66, 68
 Particle Render Type menu, 560, 560
 particles and particle dynamics, 542
 animating, **562–570**, 563–570
 nParticles, **555–556**
 attributes, **559–561**, 559–561,
 565–567, 565–567
 caching, **561–562**
 emitting, **556–558**, 556–557,
 562–564, 563–564
 Partition Set option, 407
 passive rigid bodies, **543–545**, 543–544
 patch modeling, **180**
 patches, NURBS, 112, 164, **180–191**,
 180–182

paths in axe throwing
 animation on, **368–370**, 368
 of motion, **367–368**, 367–368
 pelvis
 Inverse Kinematics for, 417–419
 for root, 391
 Penumbra attribute, 448
 Penumbra Angle attribute
 shader glows, 464
 spot lights, 446, 446
 perception of mass, 28
 periodicals, 30
 perspective view, **84–88**, 84, 87, 489
 Phase Alternation Line (PAL)
 resolution, 20
 Phong E shaders, **284**, 284
 Phong E surfaces, 284
 Phong shading, **283**, 283
 Photoshop
 files, **306–308**, 306–307
 UV coordinates in, **327–329**,
 327–329
 Physical Sun and Sky (PSAS) lighting,
 457–461, 457–461
 physics
 in motion simulation, 542
 overview, **29**
 pick walking, 392
 pipelines, 4–5
 piping in steam locomotive, 151, 151
 pivots and pivot points
 block man, 390
 center of balance as, 54
 Earth and moon, 64, 64
 joints, 388, 389
 Mercury, 57
 red wagon wheels, 259, 260
 in rigging, 377–378
 Pixel Aspect Ratio attribute, 480
 pixelated raster images, 13
 Place2dTexture nodes, **303–304**, 304
 planar surfaces, **167–169**, 168–170
 planets
 Earth, **63**, 64
 grouping, **57**, **64–65**
 Mercury, **44–45**, 45
 Pluto, **67–68**, 67
 rotation, **56–57**
 Saturn, **47–48**, 48
 Venus, 62
 planning
 models, **110–111**, 110
 production, **25**
 solar system animation, **39**
 Play Every Frame option, 544, 556
 playblasting, **68–70**, 69–70

- playing back
 - axe throwing animation, **363**
 - bouncing ball, **351**
 - wine bottle rendering, **500**
 - Pluto, **67–68**, *67*
 - pocket holes for pool table, **546**, *547*
 - point constraints, **420–421**, *421*
 - Point Density attribute, **520**
 - Point Interpolation attribute, **520**
 - Point lights, **445**, *445*
 - point of view (POV) in films, **25**
 - Poke Face tool, **121**, *121*, *127*, *127*
 - pole vector constraints, **424**
 - Poly_Hand project, **122–128**, *122–128*
 - poly meshes, details on, **128**, *129*
 - Polygon Cylinder Options dialog box, **239**, *239*
 - polygon proxies, **206**
 - Polygon tool, **116–118**, *118*
 - polygons, **109**
 - basics, **116–117**, *118*
 - for complex objects. *See* steam locomotive
 - components, **111–113**, *111*
 - converting
 - NURBS to, **176**, *177*
 - to subdivision surfaces, **206–208**, *206–208*, **213–215**, *213–215*
 - subdivision surfaces to, **216**, *216*
 - for hand, **122–128**, *122–128*
 - NURBS surfaces for, **175–176**
 - poly meshes, **128**, *129*
 - subdivision surfaces, **114–115**
 - suggestions, **161**
 - summary, **161**
 - tools for
 - Add Divisions, **129–130**, *129–130*
 - Bevel, **121**, *121–122*
 - Combine and Merge, **132–135**, *132–134*
 - Cut Faces, **135**, *135*
 - Duplicate Face, **135**
 - Extract, **136**
 - extrusion, **119–120**, *119*
 - Insert Edge Loop, **130**, *131*
 - Offset Edge Loop, **131–132**, *131*
 - Poke Face, **121**, *121*
 - Polygon, **116–118**, *118*
 - Sculpt Geometry, **136**, *136*
 - Smooth, **136**, *136*
 - Split Polygon, **130**, *130*
 - Wedge Face, **120–121**, *120*
 - Polygons menu set, **102**
 - pool table animation, **546**
 - baking out, **551–553**, *552–553*
 - curves, **553–555**, *553–554*
 - momentum, **366**
 - rigid bodies, **549–551**, *549–550*
 - table and balls, **546–548**, *547–548*
 - pose animation, **397**
 - positive space, **22**
 - post processes, Paint Effects for, **574**
 - postproduction stage, **6–8**
 - POV (point of view) in films, **25**
 - practical lighting, **442**
 - precision in animation, **355**
 - Preferences window, **55–56**, *55*, *72*, **103**, *103*
 - prefixes, filename, **477**
 - preproduction stage, **5–6**, **39–40**
 - Preserve Aspect Ratio option, **223**
 - previewing rendering, **484–485**, *485*
 - previsualization, **10**
 - primary colors, **17**
 - Primary Diffuse Scale setting, **519**
 - Primary Visibility option, **518**
 - primitives, **43**
 - shape nodes for, **58**
 - working with, **115–116**, *116*
 - procedural textures, **299**
 - procedures, MEL, **98**
 - production stages, **4–5**
 - combining, **8**
 - planning, **25**
 - postproduction, **6–8**
 - preproduction, **5–6**
 - production, **6**
 - steam locomotive, **137**, *137*
 - profile curves
 - extruded surfaces, **166**, *166–167*
 - red wagon wheels, **258–264**, *259–264*
 - revolved surfaces, **165**, *165*
 - project folders, **40**
 - projections
 - baking, **299–300**
 - on surfaces
 - curves, **177–178**
 - textures, **301–303**, *302*
 - projects
 - creating, **40–42**, *40*
 - saving, **48–49**
 - proportions in animation, **355**
 - Props modeling, **11**
 - protagonists, **24**
 - proxy objects, **371**
 - PSD file node, **306–308**, *306–307*
 - pull brushes, **192**
 - pumps, steam locomotive
 - creating, **158**, *159*
 - NURBS, **180–181**, *180–182*
 - pump arm rigging, **432**, *432*
 - push brushes, **192**
-
- Q**
- quality, rendering, **482**, *482*, *568*
 - Queue setting, **56**
 - QuickTime movie format, **16**
-
- R**
- Radial Frequency attribute, **463**
 - radiosity, **483**
 - Radius attribute
 - particles, **565**, *566*
 - spheres, **59**, *92*
 - torus, **48**
 - Radius Scale attribute, **561**, *565*, *565–566*
 - railings, red wagon model
 - creating, **264–274**, *265–273*
 - lighting, **458**, *458*
 - screws, **274–277**, *274–277*
 - shading, **338–341**, *339–340*
 - Ramp shader, **284–285**, *285*
 - ramp textures, **285**
 - color transitions, **304**, *304*
 - red wagon wheels, **310–315**, *312–315*
 - random noise patterns, **305**
 - random particle speed, **558**, *564*
 - Random Range attribute, **559**
 - Range Slider, **34**, *55*, *55*, *72*, **82**, *82*
 - ranges, frame, **478–479**, *479*
 - raster images, **13**, *14*
 - rasterization, **14**
 - Rate attribute
 - emitters, **558**
 - nParticles, **569**
 - Raytrace Options attributes, **288**
 - raytracing, **450**, *451*
 - Maya Software rendering method, **481–482**
 - for reflections, **487–488**, *488*
 - with shaders, **288**
 - for shadows, **450–454**, *451–454*
 - reading animation curves, **348–350**
 - red, green, blue (RGB) color wheel, **19**
 - red color, **18–19**
 - red wagon model, **219**
 - beginning, **220**, *220*
 - body, **249**, *250*
 - bullnose, **252–254**, *253–254*
 - decals, **321**, *321*
 - floor, **250–251**, *250–252*
 - screws, **278**, *278–279*, **342**

- Booleans, **238–243**, *238–243*
- cleaning up, **248–249**, *249*
- details, **279–280**, *279–280*
- floor
 - creating, **250–251**, *250–252*
 - texturing, **337–338**, *338*
- handlebars
 - bolts, **255–257**, *255–257*
 - creating, **254**, *254*
 - holes, **238–239**, *239–240*, **242–243**, *242–243*
 - shading, **342**
- lighting, **457–461**, *457–461*, **466–469**, *466–470*
- metal shaders, **342–343**, *343*
- railings
 - creating, **264–274**, *265–273*
 - lighting, **458**, *458*
 - screws, **274–277**, *274–277*
 - shading, **338–341**, *339–340*
- reference planes, **220–228**, *221–228*
- rendering, **529–531**, *529–531*
 - ambient occlusion, **536–540**, *537–539*
 - blurring reflections, **535–536**, *536*
 - IBL, **529–531**
 - settings, **503–504**, *503–504*
 - wrapup, **540**
- side panels
 - rounding edges, **247–248**, *247–248*
 - shaping, **228–238**, *228–237*, **244–246**, *244–246*
 - UV coordinates, **322–337**, *323–337*
- summary, **280**
- texturing, **308**, *308*
 - shader assignment, **309–311**, *309–311*
 - wheels, **311–321**, *311–320*
- toon shading, **574–577**, *575–577*
- wheels, **258–264**, *258–264*
- Redo Previous Render option, **484**, *485*
- reference planes
 - images, **222–223**, *223*
 - mapping, **224–228**, *224–228*
 - red wagon model, **220–228**, *221–228*
- Refine Selected option, **208**
- Reflected Color attribute, **288**, *291*, *292*
- Reflected Color map option, **487**
- reflection maps, **481**, *487*
- reflections, **283**
 - blurring, **535–536**, *536*
 - in rendering, **481**, **487–488**, *488*
 - with shaders, **288**, *291*, *292*
- Reflections attribute, **487**, *488*
- Reflectivity attribute, **288**, *487*
- Reflectivity slider, **291**
- refractions in rendering, **481–482**, **488–489**, *489*
- refractive index, **488**, *489*
- relationship editors for light linking
 - Light Linking window, **545**
 - Relationship Editor, **448–449**, *448–449*
- relationships in animation
 - constraints, **420–424**, *421–423*
 - set driven keys, **424–427**, *426–427*
- relative sizes in animation, **355**
- Relative Transform feature, **78**
- Remove Image option, **486**
- renaming
 - nodes, **51**
 - objects, **78**, *94*
- Render Globals window, **476**
- render node display area, **96–97**
- Render Region option, **484**, *485*
- Render Settings window, **476**, *497*, *497*
 - attributes, **568**
 - batch rendering, **496**
 - mental ray for Maya, **501**, *501*
 - mental ray lighting, **455**
 - reflections, **487**
 - tabs in, **476–477**
 - vector rendering, **484**, *484*
 - wine bottle, **497–498**
- Render View window, **480**, **484–485**, *485*
- rendering, **3–4**, **6–7**, **475**
 - Ambient Occlusion, **520–526**, *520–527*
 - attributes, **561**, *561*, **568–570**, *568–570*
 - batch, **496–497**, *496*, **500**
 - cameras in. *See* cameras
 - controls for, **78**
 - engine selection, **476–477**
 - Maya Hardware, **482–483**, *483*
 - Maya Software, **481–482**, *482*
 - Maya Vector rendering
 - method, **484**, *484*
 - mental ray for Maya, **483**
 - filenames for, **477**
 - final gathering, **517–520**, *517–519*
 - frame ranges in, **478–479**, *479*
 - HDRI, **528–529**, *528*, **535**
 - image channels in, **479–480**, *480*
 - image formats for, **477–480**
 - IPR, **486–487**, *486*
 - lighting, **443**, *443*
 - mental ray for Maya, **501–504**, *501*, *503–504*
 - motion blur, **495–496**
 - previewing, **484–485**, *485*
 - red wagon model, **529–531**, *529–531*
 - ambient occlusion, **536–540**, *537–539*
 - blurring reflections, **535–536**, *536*
 - IBL, **529–531**
 - settings, **503–504**, *503–504*
 - wrapup, **540**
 - reflections, **487–488**, *488*
 - refractions, **488–489**, *489*
 - render layers, **508**
 - batch rendering for, **515–516**, *515–516*
 - shadow passes for, **513–514**, *513–515*
 - still life, **508–511**, *509–511*
 - testing, **511**, *511–512*
 - resolution, **480**
 - saving and loading images, **486**
 - setup, **476–477**, *476*
 - solar system animation, **505–507**, *505–507*
 - summary, **540**
 - wine bottle, **497–500**, *498–500*
 - in work flow, **12**
- Rendering menu set, **102**
- Repeat UV setting, **304**
- replacing objects, **371–372**, *372*
- resolution, **19–21**
 - raster images, **13**
 - in rendering, **480**, *499*
 - subdivision surfaces, **206**
- Resolution setting
 - shader glows, **464**
 - shadow map shadows, **451**, *452*
 - volumetric lighting, **462**
- Revolve Options dialog box, **260**, *260*
- revolved surfaces, **165**, *165–166*
- RGB (red, green, blue) color wheel, **19**
- RGB Channel (Color) option, **480**
- rigging
 - skeletons
 - hands, **403–405**, **404–406**
 - legs, **415–417**, *416–417*
 - steam locomotive, **427**, *428*
 - back wheel, **433–434**, *433–434*
 - finishing, **435**, *435*
 - pump arm, **432**, *432*
 - scene setup, **377–379**, *377–378*
 - selection handles for, **379**, *379*
 - wheel arms, **429–431**, *430–431*
 - wheel control, **428–429**, *429*
- rigid binds, **406**, *406*
 - creating, **407**, *408*
 - editing, **410–412**, *410–412*

rigid bodies, 542
 active and passive, **543–545**,
 543–544
 animating, **549–551**, 549–550
 attributes, **546**, **550–551**
 moving, **545**
 pool table animation, **549–551**,
 549–550

rim light, purpose, **441**

rim lights, 26

rings for Saturn, **47–48**, 48

roofs in steam locomotive,
 153–154, 153

root joints, 388–389, 388

Rotate Frame setting, 304

Rotate tool, 89

rotating and Rotate attributes
 animation curves, 554–555
 axe throwing, 362–365, 364–365
 baking out simulations, 552
 constraints, 421
 joints, 389, 389
 keyframe, 348, 362–365, 364–365
 lens flare, 463
 Local Axis, 21
 nParticles, 559
 planets, **56–57**
 set driven keys, 425
 wheel control, 428–429

Rotation attributes, 421, 463

Roughness attribute, 289

rounding panel edges, **247–248**,
 247–248

roundness for bevels, 121

S

S Divisions attribute, 198, 211

Sample By setting, 553

Sample Lock setting, 502

Sampling Mode menu, **502**

Sampling setting, 553–554

saturation in HSV channels, 19

Saturn, **47–48**, 48

Save Scene icon, 75

saving
 images, 486
 multiple versions, **46–47**
 projects, **48–49**

Scale channels, 44

Scale keyframe, 348

scale manipulator, 44

Scale tool, 89

scaling and Scale attributes
 bouncing ball, 348, 353
 constraints, **421–422**, 422
 nParticles, 559

raster images, 13

reference planes, 227

spheres, 59, 92

sun, 44

vector graphics, 14, 15

Scene End Frame setting, 55, 55

Scene File Icons, 75

Scene Start Frame setting, 55, 55

scenes, 25
 assembling, 7–8
 saving, 46–47

Scenes folder, 40

scenics, 11

screen components, **34–35**, 35, 72, 73
 Channel Box/Layer Editor,
80–82, 81
 Command line, **83–84**, 83
 main menu bar, **73–74**
 shelf, **79–80**, 79
 Status line, **75–79**, 75
 Time Slider and Range Slider,
82, 82
 Tool Box, **80**, 80

screws, red wagon model
 body, **278**, 278–279
 railings, **274–277**, 274–277
 shading, **342**

Script Editor, 83, **98–99**, 98, 104

scripts, 5, 83, 98

scroll wheel, 36, 85

scrubbing Timeline, 56, 82

Sculpt Geometry tool, **136**, 136,
 191, 192

SDKs (set driven keys), **424**
 creating, **424–425**, 425
 for hands, **425–427**, 426–427

secondary motion
 animation, 365
 axe throwing, **366–367**, 367

sections for primitives, 116

segments for bevels, 121

Select a Renderer option, 485

Select by Name feature, 78

Select Camera option, 489

Selected Color attribute, 296, 568

Selected Joints option, 407

selecting isoparms, 179

selection handles
 for axe, 358
 in rigging, **379**, 379

selection masks, **75–76**

selection modes, **75–76**

selections, **37**

Separate option, 135

Separate Extracted Faces option, 136

separator bar, 94

sequence image planes, **495**, 495

sequences in acts, 25

Set Active Key option, 549

set driven keys (SDKs), **424**
 creating, **424–425**, 425
 for hands, **425–427**, 426–427

Set Key Options dialog box, 52, 52

Set Passive Key option, 549

Settings category, 103

Settings tab, 55, 55

setup for animation, 11

SGI (Silicon Graphics Image) files, 478

Shaded Brightness Two Tone option,
 574, 576

shaded mode, **87–88**, 87

shader glows, **464–465**, 464–465

shading and shaders, 11, **281–282**
 attributes, **285–289**, 286–288,
560–561, 560–561
 axe metal spike, **295–298**, 295–298
 axe wooden handle, **293–295**,
 293–295
 nParticles, 569, 569
 Paint Effects, 573
 red wagon model, **309–311**,
 309–311
 panels, **322–337**, 323–337
 railings, **338–341**, 339–340
 wheels, **311–321**, 311–320
 solar system animation, **50–54**,
 50–54
 toon, **574–577**, 575–577
 types, **282–285**

Shading attribute, 573

shadow maps, **450–454**, 451–454

shadow passes for render layers, **513–**
514, 513–515

shadows, **449–450**, 450
 creating, **450–454**, 451–454
 lighting for, 438
 per object, **453**
 raytracing, **453–454**, 453–454
 shadow map, 451

Shake and After Effects program, 7

shape nodes, 58

shapes
 primitives, 58, **115–116**, 116
 red wagon model panels, **228–238**,
 228–237, **244–246**, 244–246
 in vector images, 14
 shelf, 34, 72, **79–80**, 79, **104**, 104
 Shelves Editor, 104, 104

shortcuts, keyboard
 capital letters with, 88
 customizing, **104–105**, 105
 overview, **36**
 for viewing, **85**

shots, 25

- Show Frame Numbers option, 367
- Show Manipulator tool, 472, 472
- Shutter Angle attribute, 496
- sibling nodes, 68
- side panels
 - red wagon model
 - rounding edges, 247–248, 247–248
 - shaping, 228–238, 228–237, 244–246, 244–246
 - UV coordinates, 322–337, 323–337
 - steam locomotive, 151, 151
- Silicon Graphics Image (SGI) files, 478
- Simplify Method setting, 554
- simulations
 - baking out, 551–553, 552–553
 - motion, 542
- single-node cameras, 490, 490
- 16-bit image files, 16
- size
 - in animation, 355
 - windows, 86
- skeletons, 388
 - attaching geometry to, 395, 395–396, 406
 - binding, 406–410, 406, 408
 - rigid binds, 409–412, 409–412
 - smooth binds, 412–415, 413–414
 - creating, 391–394, 393–394
 - detaching, 408
 - Forward Kinematics for, 390, 390
 - hands. *See* hands
 - hierarchical system, 388–389, 388
 - Inverse Kinematics for, 415–420, 416–420
 - walk cycle for
 - Forward Kinematics, 396–402, 397–401
 - Inverse Kinematics, 417–419, 418–419
- skin weights, painting, 412–415, 413–414
- skinning, 406
- sky, 457–461, 457–461
- smooth binds, 406, 406
 - creating, 407–408, 408
 - editing, 412–415, 413–414
- Smooth option
 - side panels, 237, 237
 - surfaces, 193
- Smooth tool, 116, 136, 136
- snaps, 45–46, 77
- soft bodies, 542
- Soft Modification tool, 90
- soft shadows, 453–454, 453–454
- software particles, 560
- solar system animation
 - creating, 54–57, 55, 61–66, 64
 - moons, 49, 49
 - Outliner for, 66–68, 66–67
 - outputting, 68–70, 69–70
 - overview, 39
 - planets, 44–45, 45
 - planning, 39–40
 - project for, 40–42, 40
 - rendering settings, 505–507, 505–507
 - Saturn rings, 47–48, 48
 - saving, 48–49
 - shaders for, 50–54, 50–54
 - summary, 70
 - sun, 42–44, 45
- sound design, 8
- sound effects, 8
- South zone, hotbox, 100, 100
- space
 - 3D coordinate, 21, 22
 - in design, 22
- spans and spanning
 - curves, 164
 - primitives, 116
 - surfaces, 112, 172, 173
- Sparse Curve Bake option, 552–553
- Special Manipulator tool, 302, 302
- Specular Color attribute, 288
- specular highlight, 283
- specular lighting, 443, 443
- Speed attribute, 558
- Speed Random attribute, 558, 564
- spheres
 - attributes, 91–93, 92–93
 - creating, 302, 302
 - lattices for, 201–202, 202–203
 - in solar system animation. *See* solar system animation
 - transform nodes for, 59
 - UV coordinates, 321–322, 322
- spike, axe, 295–298, 295–298
- Spin Impulse attribute, 551
- spline IK chains, 419, 420
- Split Polygon tool, 126, 130, 130, 204–205
- spokes, wheel, 156, 156
- Spot lights, 445–446, 446
- spout, teakettle, 215, 215
- Spread attribute
 - lens flare, 463
 - particles, 564, 564
- squash
 - in animation, 28
 - in bouncing ball, 353, 353
- standard resolutions, 20
- Star Points attribute, 463
- starfish model, 204–208, 204–208
- Start Frame attribute, 478
- Static Friction setting, 546
- status line, 34, 72, 75–79, 75
- steam, animating, 562–570, 563–570
- steam locomotive, 136–137
 - animating, 562–570, 563–570
 - axles, 158, 158–159
 - boiler caps
 - end, 182–186, 183–186
 - front, 140–143, 140–142
 - topside, 151, 151
 - boiler engine
 - cabin, 152–154, 152–154
 - chimneys, 148–149, 148–149
 - cowcatcher, 146, 147
 - drive mechanism, 159, 159
 - lightbox, 150, 150
 - pipng and tanks, 151, 151
 - production process, 137, 137
 - pumps
 - creating, 158, 159
 - NURBS, 180–181, 180–182
 - pump arm rigging, 432, 432
 - rigging. *See* rigging
 - side panels, 151, 151
 - stitching and tangency, 180, 186–191, 187–191
 - undercarriage, 143–148, 143–147
 - wheels, 155–157, 155–157
- still life, rendering, 508–511, 509–511
 - batch rendering for, 515–516, 515–516
 - shadow passes for, 513–514, 513–515
 - testing, 511, 511–512
- stitching, 180, 186–191, 187–191
- storyboards, 5–6, 9
- stretch
 - in animation, 28
 - in bouncing ball, 353, 353
- strokes, Paint Effects, 571–572
- subdividing cubes, 153
- subdivision surfaces, 114–115, 117, 203–204
 - converting
 - to polygons, 216, 216
 - polygons to, 206–208, 206–208, 213–215, 213–215
 - summary, 217–218
 - teakettle base polygon model, 209–212, 209–213
- Subdivisions Height setting, 194, 194
- subtractive color, 17–18
- suggested reading, 30–31

sun

- creating, **42–44**, 45
- mental ray rendering, **457–461**, 457–461

Surface Shading attribute, 561

surfaces

- NURBS. *See* NURBS (Non-Uniform Rational B-Splines) modeling and surfaces
- projections for, **301–303**, 302
- revolved, **165**, 165–166
- subdivision. *See* subdivision surfaces
- texture nodes for, **303–308**, 303–308
- UV mapping, **300–301**

Surfaces menu set, 102

symmetrical objects, **23**, 23

syntax, **35**

importing image files as,

305–306, 305

in lighting, 12

mapping, 282

metal shaders, **342–343**, 343

nodes, **303–308**, 303–308

projections for, **299–303**, 302

red wagon model, **308**, 308

bullnose, **341**, 342

floor, **337–338**, 338

railings, **338–341**, 339–340

shader assignment, **309–311**, 309–311

wheels, **311–321**, 311–320

summary, **344**

types of, 299

UV mapping, **300–301**

in work flow, **11**

three-button mouse, 72

three-node cameras, 490, 490

three-point lighting, 26, **439–442**, 440–441

3D artists, 2

3D objects and space, **21**, 22

animation, **4**

blur process, 495

creation process, **3–4**

polygons for. *See* polygons

textures, **307**

3dplacement node, 299

Threshold attribute, 561

throwing axe, **354**

animation curves, **360–363**, 361

anticipation, **359–360**, 361

follow-through, **363–366**, 364–366

keyframes for, **357–366**, 364–366

motion trails, **367–368**, 367–368

path animation, **368–370**, 368

playing back, **363**

preproduction process, **354**

replacing axe, **371**

scene setup, **354–357**, 355–357

secondary motion, **366–367**, 367

summary, **370–371**

targets, **356–357**, 357

thumbs, 125, 126

TIFF (Tagged Image File Format) files, 16, 478

TIFF16 files, 16

time indicator, 82

Time Range setting, 554

Time settings, 103

Time Slider, 34, 55, 55, 72, **82**, 82

Time Snap icon, 361

Time Tolerance setting, 554

Timeline scrubbing, 56, 82

timing for bouncing ball, **352**, 353

tint in HSV channels, 19

toe joints, 388, 388

Tool Box, 34, 72, **80**, 80

Tool Options window, 79

Toolbox for shelves, 104

toon shading, **574–577**, 575–577

torus for rings, 47–48

train. *See* steam locomotive

Transfer Attribute Options dialog box, 331, 331

transferring animation, **371–372**, 372

transform nodes, 58–59

transformations, freezing, 180–181, 180, 346, 367

Translate Frame setting, 304

Translate keyframes

axe throwing, 360–362, 366

bouncing ball, 348

translations and Translate attributes

axe throwing, 366–368

baking out simulations, 552

bouncing ball, 347, 349

IK walk cycle, 418

nParticles, 559

point constraints, 420

set driven keys, 425

spheres, 59, 92

Translucence attribute, 287

Translucence Focus attribute, 287

Transparency attributes

nParticles, 570

Paint Effects, 573

shaders, **285**

wood texture, 296

Triangulate option, 118

Trim option, 373

trimmed surfaces, 167, **178**

troubleshooting, **360**

True Color images, 16

true reflections, **481**

Tube Shading attribute, 573

Tube Width1 and Width2

attribute, 573

Tubes per Step attribute, 573

two-node cameras, 490, 490

2D blur process, 495

2D texture placement, **303–304**, 304

24-bit color images, 16

Type menu for lighting, 442

Type setting

ramp gradients, 304

text, 373

T Divisions attribute, 198, 211

table, creating, **546–548**, 547–548

Tagged Image File Format (TIFF) files, 16, 478

tangency

constraints, 424

handles for, 348, 349, 365, 365

in patch modeling, **186–191**, 187–191

tanks in steam locomotive, 151, 151

Targa format, 16, 478

targets for axe throwing, **356–357**, 357

teakettle model

base polygon model, **209–212**, 209–213

converting polygons to subdivision surfaces, **213–215**, 213–215

converting subdivision surfaces to polygons, **216**, 216

details for, 217

tears, fixing, **240–241**, 240–242

tessellation, 115

boiler, 149

NURBS surface, **175–176**

red wagon wheels, 261

text, flying, **372–375**, 373–376

Texture Display mode, 312

texture shaded mode, 88

texturing and textures, **281–282**

3D, **307**

axe, **289**

metal head, **290–293**, 291–292

metal spike, **295–298**, 295–298

wooden handle, 293–295, 293, 295

U Divisions attribute, 198, 211
 U Wave attribute, 304
 UI. *See* interface
 undercarriage, boiler engine, **143–148**,
143–147
 underlighting, 438, 439
 Union operator, 238
 Universal Manipulator tool, 89–90, 89
 untrimming NURBS surfaces, **178**
 Up Axis setting, 374
 Up Vector setting, 422
 Use Background shader, 283
 Use Default Material option, 312
 Use Depth Map Shadows option, 450
 Use Image Sequence option, 495
 Use Ray Trace Shadows option, 452, 454
 Use Selected Curve For Extrusion
 option, 120
 User Interface. *See* interface
 UV coordinates, **321–322**, 322
 copying, **331–332**
 mapping, **300–301**
 Photoshop, **327–329**, *327–329*
 red wagon panels, **322–337**,
 323–337
 UV Snapshot dialog box, 326, 326
 UV Texture Editor, 322–326, 323–326,
 332–333, 333
 UVSnapShot layer, 307

U

ViewCube, 85
 views
 keyboard shortcuts for, **85**
 normalizing and denormalizing,
 361, 361
 Visor window, 571, 571
 volume, emitter, 557, 558
 Volume Light Dir attribute, 448
 Volume lights, **447–448**, 447
 volumes in vector images, 14
 volumetric lighting, **462**, 462

W

walk cycles
 Forward Kinematics, **396–402**,
 397–401
 Inverse Kinematics, **417–419**,
 418–419
 warm colors, 18, 24
 Water texture, 305
 wave deformers, 423
 websites, suggested, 30
 Wedge Face tool, **120–121**, *120*, 124,
125, 145
 wedges for undercarriage, 145, *146*
 weight
 in animation, **28–29**, 357
 in axe throwing, 363
 weights, painting, **413–415**, *413–414*
 weld plates, 141
 West zone, hotbox, 100, *100*
 wheel arms
 creating, 157, 157
 rigging, **429–431**, *430–431*
 wheels
 red wagon model
 modeling, **258–264**, *258–264*
 shading, **311–321**, *311–320*
 steam locomotive
 back, **433–434**, *433–434*
 creating, **155–157**, *155–157*
 rigging, **377–379**, *377–379*,
 428–429, 429
 Whiteness attribute, 289
 Widescreen aspect ratio, 20
 width
 aspect ratio, 20

 resolution, 480
 space, 21
 winch for catapult, **379–381**, *380–381*
 Window menu, 74
 wine bottle rendering, **497–500**,
498–500
 wireframe mode, **87–88**
 Wireframe On Shaded option, 144
 wireframes
 for undercarriage, 144
 in vector programs, 14
 wood material, 293, 296, 296
 wood railings, red wagon model
 creating, **264–274**, *265–273*
 lighting, 458, 458
 screws, **274–277**, *274–277*
 shading, **338–341**, *339–340*
 Wood texture, 293–294
 wooden axe handles, **293–295**,
293–295
 work area, Hypershade, **96–97**
 work flow, **9**
 animation, **11**
 lighting, **11–12**
 modeling, **9–11**
 rendering, **12**
 texturing, **11**
 Working Units settings, 103
 workspace, 34, 74
 World Axis, 21, 22
 World Space, 21
 Wrap U option, 304
 Wrap V option, 304

X

X-Ray mode, 269, 269
 XYZ coordinate space, 21

Y

Y-Axis Rotation setting, 65–66
 Y Translation keyframes, 347

Z

zones, hotbox, 100, *100*

