1:1 reference chart, front inside cover
using with axles, 8
using with beams, 8
90-degree turns
making when steering, 35
performing via Rotation Sensor, 83
180-degree turn, making in place, 35

Symbols
< (less than) value, comparing, 175
= (equal to) value, comparing, 175
> (greater than) value, comparing, 175

A
Action blocks, using with Complete Palette, 105
And operation, output value for, 176
arithmetic operations, capabilities for, 171
arrow buttons, tracking presses of, 188
autonomous mode
operating Shot-Roller in, 87
using with Shot-Roller, 108
axles
building tip, 8
determining length of, 8
pushing in, 18

B
batteries, inserting, 5–6
beams
building tip for Explorer, 8
finding length of, 8
using with grabbing mechanism, 198
using with lifting mechanism, 198
beeping alarm, creating, 66
bill of materials for Explorer, 8
break data wire, 166
buckets
calculating positions of, 262
dropping bricks in, 263
finding bricks for, 259
finding for Hybrid Brick Sorter, 259
getting sizes of, 261

C
cables
attaching for Touch Sensors, 73
connecting, 19
connecting for Hybrid Brick Sorter, 259
connecting for Shot-Roller, 105
connecting to Explorer, 19
short versus long, 19
types of, 4, 19
wiring, 19
catalog numbers
for LEGO rechargeable batteries, 5
for transformers, 5
CCC (Compact Chimney Climber)
balancing on x-axis, 266–267
balancing on y-axis, 267
building, 269–279
climbing and staying balanced, 280–281
climbing technique, 266–267
crane technique, 281
detecting balance errors, 267
extending arms for, 280
function of, 265
going down, 282
Motor blocks in, 280
preparing chimney for, 280
required pieces for, 268
solving balance errors, 267
spotting ceiling, 282
staying balanced, 282
stopping, 282
troubleshooting, 282
warning about, 265
Wheel motors, 280–281
chimney, preparing for CCC, 280
circles, displaying, 40
climbing technique, 266–267
Closet variable, using with Snatcher, 232
colored balls, identifying colors of, 85
colored line, staying inside of, 79
Color Lamp block, using with Shot-Roller,
105, 106, 111
color, saying name of, 80
Color Sensor, 55, 56
connecting to Discovery robot, 78
creating attachment for, 76, 78
creating line-following robot, 81
Discovery-Circle program, 79
function in Light Sensor mode, 112
Inside Range option, 78
Outside Range option, 78
polling via View mode, 78
programming with, 78–79
seeing black, 81
seeing white, 81
using with Brick Sorter, 262
using with Shot-Roller, 111

The LEGO MINDSTORMS NXT 2.0 Discovery Book
(C) 2010 by Laurens Valk
Color Sensor block configuring, 162
Detected Color plug on, 162
color value, multiplying via Math block, 172
comments, including in programs, 29
Comment Tool, 29
Common blocks, using with Complete Palette, 105
Compact Chimney Climber (CCC). See CCC (Compact Chimney Climber)
companion website, xx
Compare block
Smart-Compare program, 175
using with Smart-Game program, 191
Compare setting, using with Ultrasonic Sensors, 159
Complete Palette, using with Shot-Roller, 105
conditions, using with Switch blocks, 62, 177
configuration icons, 35
Configuration Panel, 27, 28
accessing boxes on, 45
displaying, 27
for Move block, 33–34
connections
listing NXT devices for, 286
to NXT via Bluetooth, 289
to NXT with USB, 286
setting up manually, 286
Constant blocks, 188
constants
Custom block for, 188–189
defining, 188
Smart-Constant program, 188–189
controller. See NXT controller
Control Motor Power option, using with Shot-Roller, 107
Copy button, 28
C output port, connecting motors to, 19
Cut button, 28

data blocks
Compare block, 175
Logic block, 175, 176
Math block, 171, 173
Random block, 174
data hubs, 149
closing, 158
creating and connecting data wire, 157
input and output plugs on, 159
input plugs on, 157
opening for blocks, 158
opening for blocks in Smart-Intro program, 157
output plugs on, 167
data plugs
Direction plug, 169
hiding when unused, 169
using help for, 168–169
data plugs, input and output, 159
data wires, 149
blocks and configurations for, 160
broken data wire, 166
configuring Switch blocks with, 178–179
connecting to blocks, 166–167
connecting to data plugs, 167
connecting to different plugs, 166
connecting to inside Switch blocks, 180
creating and connecting, 157
deleting, 160
error messages, 287–288
function of, 163
managing, 169
Smart-LogicWire program, 164
types of, 163–166
using across programs, 169–170
using to end loops, 180
decisions, repeating for robots, 65
degrees, finding number of, 35
deleting
blocks, 26
data wires, 160
files, 287
variables, 184
DemoV2 program, running, 21
Direction plug, 169
direction signs, finding, 41
Direction variable, using with Snatcher, 233
Discovery-Avoid program, 60
Discovery-Bumper program, 74–75. See also bumper attachment
Discovery-Button program, 82
Discovery-Circle program, 79
Discovery-Loop program, 61
Discovery-Repeat program, 65
Discovery robot. See also Explorer robot; robots
with bumper attachment, 67
connecting Color Sensor to, 78
enhancement of, 55
Discovery-Rotation program, 83–85
Discovery-Switch program, 62–64
Discovery-Touch program, 73–74
Discovery-Wait program, 58–59
Display blocks, 38
Action setting, 39
Display box, 39
displaying drawings, 40
displaying images, 39
displaying text, 39
in Explorer-Display program, 40–41
testing, 40–41
Type box, 40
using with Strider robot, 140
distance
detecting via sensors, 56
measuring for Ultrasonic Sensor, 66
dots, displaying, 40
Download and Run button, 25–26
Download button, 27
downloading programs to NXT, 285–288
drawings, displaying, 40
drive track, 42
Driving module, for Hybrid Brick Sorter, 238
Driving motor, for Hybrid Brick Sorter, 238
Drop Brick My Block, creating for Brick Sorter, 260
duration Unlimited setting, using with Move block, 45–46

E
Enter button
using to choose items, 20
using to turn on brick, 23
equal to (=) value, comparing, 175
error messages
cannot download needed file for program, 288
data wires, 287–288
the file is currently in use, 288
the NXT device is no longer connected, 287
the NXT device is out of memory, 287
the program is broken . . . missing files, 288
troubleshooting, 25
Exit button
using to abort programs, 21
using to access previous menu, 20
using to turn off brick, 20
Explorer-Display program, Display blocks in, 40–41
Explorer-Loop program, 47
Explorer-Move program, 32
Explorer-Parallel program, 50, 51
Explorer robot. See also Discovery robot, robots
accelerating, 34
adjusting speed of, 30
bill of materials for, 8
building, 9–18
connecting cables to, 19
controlling remotely, 30
making drive backward, 32–33
moving back and forth, 48
moving in square, 46
selecting pieces for, 7
testing, 21
tips for friction and nonfriction pins, 8
turning, 34–35
Explorer-Sound program, 36
Explorer-Unlimited program, 45
Explorer-Wait program, 43–44
Feedback Boxes, using to poll sensors, 142
files, removing from NXT’s memory, 287
Find Object My Block, creating for Snatcher, 232–233
Firing motor, function in Shot-Roller, 88
fixed pen, lifting up, 42
Flat View option, using with Switch blocks, 64
Flow blocks, using with Complete Palette, 105
friction pins, building tip for, front inside cover, 8
G
game. See Smart-Game program
gears, using with Snatcher, 198–199
“Goodbye” and “Hello,” programming for robot, 59
Grabber motor, using with Snatcher, 197
grabbing mechanism. See also Snatcher robotic arm
beams used with, 198
using with Snatcher, 198–199
Grab My Block, creating for Snatcher, 232
greater than (>) value, comparing, 175
H
“Hello” and “Goodbye,” programming for robot, 59
Help Window, 27
house, robotizing, 85
Hybrid Brick Sorter. See also bricks building, 240–258
calculating position of bucket, 262
checking bricks for sorting, 261
connecting cables for, 259
Driving module, 238
Driving motor, 238
Drop Brick My Block, 260
function of, 237
getting brick size for, 261
identifying size of bricks, 238
overview of, 259–260
required pieces for, 239
Reset Sorter My Block, 260
Scanning module, 238
sorting technique, 238
I
images, displaying, 39
input plugs
using settings with, 167–168
using with SmartBot, 159
input ports
selecting for Color Sensor, 78
using with sensors, 56
inventory sheet, locating, 4

INDEX 293

The LEGO MINDSTORMS NXT 2.0 Discovery Book
(C) 2010 by Laurens Valk
INDEX

The LEGO MINDSTORMS NXT 2.0 Discovery Book
(C) 2010 by Laurens Valk
repeating sequences of, 46–48
selecting, 25
on Sequence Beam, 31
Sound block, 36–38
types of, 31
using to create programs, 31
Programming Palettes, 25
Program Navigation Bar, 27, 28
programs
aborting, 21, 285
closing, 28
comments in, 29
configuring blocks in, 45
creating, 23, 25
creating with programming blocks, 31
downloading to NXT, 25, 285–288
downloading without running, 27
finding downloads to brick, 26
managing, 28
modifying, 28–29
navigating between, 28
navigating to parts of, 29
pausing via Wait block, 58–60
running, 21
running manually, 26
transferring to NXT brick, 26–27

R
Random block
Smart-Random program, 174
using with Smart-Game program, 191
rechargeable batteries, catalog
numbers for, 5
Redo button, 29
Released action, detection by Touch Sensor, 68
Release My Block, creating for Snatcher, 232
Remote Control, 30
remote-control mode, operating Shot-Roller in, 87, 113–114
Repeat checkbox, using with Sound block, 36
Reset, selecting in Switch block, 85
Reset Sorter My Block, creating for Brick Sorter, 260
Right Arrow button, pushing, 82
Right Touch Sensor, 73, 76
Robo Center, 27, 29, 30
robots. See also Discovery robot;
   Explorer robot
   repeating decisions of, 65
   testing mechanical functions for, 107
   Rotation Sensor, 84
   Rotation Sensor block, configuring, 163
   Rotation Sensors
   behavior of, 83
   Discovery-Rotation, 83–85
   making programs with, 83–85
   polling via View mode, 83
   resetting, 84–85
   S
Say Color My Block, creating, 80
Scanning module, using with Hybrid Brick Sorter, 238
score
   adjusting in Smart-Game program, 192
   displaying in Smart-Game program, 193
Score variable, using with Smart-Game, 190
   “seeing” behavior, sensor for, 56
   selecting items, 20
   Sensor blocks
   configuring, 162
   using to perform sensor measurements, 166
   using to poll sensors, 162
   using with Complete Palette, 105
   sensor cables, connecting for Strider robot, 134
   sensor data, basing decisions on, 62
   sensor readings, viewing, 56
   sensors
   Color, 55, 56
   connecting for Shot-Roller, 105
   Light, 111
   polling, 56, 57
   polling via Feedback Boxes, 142
   Rotation, 83
   Touch, 55
   triggering, 58
   types of, 55
   Ultrasonic, 55
   using with Loop block, 60–61
   using with Switch blocks, 62–65
   and Wait block, 58–60
   sensors, use of, 4
   Sequence Beam, programming blocks on, 31
   Shot-Roller
   autonomous mode, 108
   building, 88–104
   Color Lamp block, 105, 106
   Complete Palette, 105
   connecting cables for, 105
   Control Motor Power option, 107
   creating a catapult for, 119
   defending territory with, 112
   Firing motor, 88
   Light Sensor mode, 111
   Mot blocks, 106, 107, 118
   MotorControlTest program, 107
   remote-control mode, 113–114
   required pieces for, 88
   Shot-Roller-Light program, 112–113
   Shot-Roller-Remote program, 114–118
   TestColorLamp program, 106
   turning into intruder alarm, 111
   Turn motor, 87, 114–115
   Turret motor, 87, 116
   Shot-Roller-Light program, 112–113
   Shot-Roller-Remote program, 114–118
   Smart-Accelerate program, 158–159
   SmartBot
   accelerating motor for, 158
   building, 150–155
   required pieces for, 150
   Smart-Intro program, 156
   using loop count with, 158
   Smart-Compare program, 175
   Smart-Constant program, 188–189
   Smart-Count program, 186–187
   Smart-Game program
   adjusting score in, 192
   comparing position and button variables, 192
   defining variables for, 190
   displaying current score, 193
   displaying target randomly, 191
   expanding, 193–194
   overview of, 190
   repeating for 30 seconds, 193
   storing pressed button, 191
   waiting until button is pressed, 191
Smart-Intro program
blocks for, 156
open data hubs for blocks, 157
overview of, 157
Sound blocks in, 157
Ultrasonic Sensor block in, 157
Smart-Logic program, 175–176
Smart-LogicWire program, 164, 166–167
Smart-Loop program, 180–181
Smart-Math program, 171–173
Smart-Random program, 174
Smart-Sound program, 172–173
Smart-Switch program, 178–179
Smart-TextWire program, 165
Smart-Touch program, 177
Smart-Variable program, 185
Snatcher robotic arm. See also grabbing mechanism
building, 201–230
Find Object My Block, 232–233
function of, 231
gears for, 198–199
Grabber motor, 197
 grabbing mechanism, 198
grasping objects with, 234
Grab My Block, 232
lifting mechanism, 198–199
Move Closer My Block, 234
overview of, 231
Release My Block, 232
required pieces for, 200
Say Color My Block, 234
troubleshooting, 235
Sound block
Action setting, 36
with Configuration Panel, 36
Configuration Panels for blocks, 37
configurations, 36
Control box, 36
creating program for, 37–38
File box, 36
Function box, 36
function of, 172
selecting notes from keyboard, 37
in Smart-Intro program, 157
in Switch blocks, 84
using with Strider robot, 140
Volume setting, 36
Wait box, 37
Sound Editor, using, 36
sound files, creating, 36
sounds
 aborting, 36
repeating, 36
types of, 36
 square-shaped patterns, driving in, 46
Start Area, 26
straight line, following, 61
Strider robot
building, 122–133
connecting sensor cables for, 134
creating Walk-Forward My Block, 135
leg pairs, 134
minifigures for walking technique, 134
motor assemblies, 122, 135
motor direction for motor blocks, 137
NXT motors, 135
power settings for motor blocks, 137
Strider-Touch program, 137–138
on three wheels, 146
using Display Blocks with, 140
using My Blocks in interactive program,
 137–141
using Sound Block with, 140
walking technique, 134–135
Walk-Left My Block, 136
Walk-Right My Block, 136
Strider-Scared program
creating, 144
polling sensors with Feedback
Boxes, 142
setting threshold values for, 142–143
Switch blocks
adding blocks to, 64
behavior of, 65
configuring, 62–63
configuring with data wires, 178–179
decreasing size of, 64
Discovery-Repeat program, 65
Discovery-Switch program, 62–64
displaying on Work Area, 64
Flat View option, 64
placing My Blocks in, 138
selecting Reset in, 85
 sensors polled by, 74
Smart-Switch program, 178–179
Smart-Touch program, 177
Sound blocks in, 84
using conditions with, 62–65
using Number data wires with, 180
using sensors with, 62–65
using Text data wires with, 180
using to follow lines, 81
using with Shot-Roller, 109, 116–117
using with Smart-Game program,
  191–192
switches, repeating, 65

T
TestColorLamp program, 106
Test Pad, 5
Text data wire, 164
  Number to Text block, 165
Smart-TextWire program, 165
using, 180
text, displaying, 39
text lines, displaying on NXT screen,
  164–165
threshold values, setting for Strider-Scared
program, 142–143
Tone Frequency plug, 172
tones, playing, 36, 84
Toolbar
  buttons for managing programs, 28
  buttons for modifying programs, 28–29
  buttons on, 28
  Comment Tool, 29
  Pan Tool, 29
  Pointer Tool, 29
Touch Sensor block, configuring, 162
Touch Sensors, 55
  actions detected by, 68
  bumper attachment with, 68–72
  connecting cables for, 73
detecting pressed status of, 177
Discovery-Touch program, 73
Left Touch Sensor, 73
polling via Wait block, 73
programming with, 73
Right Touch Sensor, 73
Smart-Count program, 186–187
using to avoid walls, 74–75
using with Strider robot, 139–140
transformer, catalog number for, 5
triangle-shaped patterns, driving in, 48
trigger value
  configuring for Rotation Sensor, 83
  using with sensors, 58
tunes, playing, 61
Turn motor
  function in Shot-Roller, 87
  using with Shot-Roller, 114–115
turns
  curving, 36
  making accurately, 35
Turret motor
  function in Shot-Roller, 87
  using with Shot-Roller, 116

U
Ultrasonic Sensor, 55, 56
  Compare setting, 159
  using in Smart-Intro program, 157
  using to avoid walls, 60
  using Wait block with, 58–59
Ultrasonic Sensor reading, displaying on NXT screen, 165
Undo button, 29
Unlimited option, using with Move block, 45
  problems with, 45

V
Variable block, configuring, 184
variables
  Bricksize for Hybrid Brick Sorter, 261
  Bucket for Hybrid Brick Sorter, 262
  Button for SmartBot, 190
  changing values for, 186
  Closest for Snatcher, 232
  defining, 183, 184
  defining for Smart-Game program, 190
  deleting, 184
  Direction for Snatcher, 233
  initializing, 186–187
  Position for SmartBot, 190
  Score for SmartBot, 190
  Smart-Count program, 186–187
  Smart-Variable program, 185
  storing values in, 184
View menu, viewing sensor readings on, 56, 57
View mode
  using to poll Color Sensor, 78
  using to poll Rotation Sensor, 83
  voice, recording with microphone, 36

W
Wait blocks, 43
  Configuration Panel, 58
  creating Explorer-Wait program, 43–44
  Discovery-Wait program, 58–59
  on Programming Palette, 74
  settings, 43
  using sensors with, 58–60
  using to poll Touch Sensor, 73
  using with Color Sensor, 79
  using with Shot-Roller, 109–111
Walk-Forward My Block, creating for Strider robot, 135
Walk-Left My Block, creating for Strider robot, 136
Walk-Right My Block, creating for Strider robot, 136
walls
  avoiding via Touch Sensors, 74–75
  avoiding via Ultrasonic Sensor, 60–61
website, companion, xx
Wheel motors, using with CCC, 280–281
wires. See data wires
Work Area
  displaying Switch blocks on, 64
  moving, 29
  placing blocks in, 26

X
XOr operation, output value for, 176

Y
Yes/No output plug, controlling, 159