

CONTENTS

PREFACE	xi
PROLOGUE	
FROM ELECTOPIA, THE LAND OF ELECTRICITY	1
1	
WHAT IS ELECTRICITY?	13
Electricity and Everyday Life.....	14
Electrical Units.....	15
Electricity in the Home.....	19
How Electricity Works.....	25
The True Nature of Electricity.....	26
Current and Electrical Discharge.....	30
Atomic Structure and Conductivity.....	34
Static Electricity.....	36
The Triboelectric Series.....	40
Uses of Static Electricity.....	43
Tags on Consumer Electric Products.....	45
Voltage and Potential.....	46
Atoms and Electrons.....	47
Static Electricity.....	49
Electrostatic Force.....	49
The Triboelectric Series.....	51
Movement of Charge and Direction of Current.....	51
2	
WHAT ARE ELECTRIC CIRCUITS?	55
Electric Circuits in Everyday Devices.....	56
A Flashlight's Circuit.....	59
Parts of an Electric Circuit.....	61
Ohm's Law and Methods of Connecting Electrical Components.....	67
Electric Circuits and Ohm's Law.....	68
Series and Parallel Connections.....	69
Electric Circuits and Current.....	73
Graphical Symbols.....	73
Direct Current Circuit and Alternating Current Circuit.....	74
Ohm's Law.....	76
Resistivity and Conductivity.....	77
Effective Resistance.....	78

3	
HOW DOES ELECTRICITY WORK?	81
Why Does Electricity Produce Heat?	82
Electricity and Joule Heat	85
How Is Heat Generated by Current?	87
Thermal Emission and Luminescence	90
Current and Magnetic Fields	94
Fleming's Left-Hand Rule (For DC Motors)	98
Fleming's Right-Hand Rule (For Generators)	100
Joule Heat	104
Thermal Vibration	104
Electromagnetic Waves	106
Electricity and Magnetism	107
Fleming's Left-Hand Rule and Motors	109
Fleming's Right-Hand Rule and Electric Generators	110
Electricity and Coils	111
Coils and Electromagnetic Induction	111
Coils and Inductance	112
Coils and Alternating Current	113
Coils and Transformers	114
Capacitors	115
Capacitors and Alternating Current	115

4	
HOW DO YOU CREATE ELECTRICITY?	117
Generators	118
How Does a Power Generator Create Electricity?	121
Batteries and Other Sources of Electricity	124
Chemical Cells	126
What Happens in a Dry Cell Battery?	132
Water and Fuel Cells	135
Anodes and Cathodes	138
Creating Your Own Coin Battery	140
Thermopiles	141
Electricity Created by a Power Plant	147
Thermal Power Generation	149
Nuclear Power Generation	151
Hydroelectric Power Generation	152
Wind Power Generation	154

5

HOW CAN YOU CONVENIENTLY USE ELECTRICITY? 155

What Are Semiconductors? 161

Diodes and Transistors 169

 Diodes That Emit Light 174

 Transistors 176

Diodes 186

Transistors 188

Field-Effect Transistor 188

Converters and Inverters 189

Sensors 190

 Temperature Sensors 190

 Optical Sensors 192

EPILOGUE 197

INDEX 201