

CONTENTS

INTRODUCTION	xiii
CHAPTER 1 PEST MANAGEMENT	1
Pest Problems throughout History	1
Pest Control Over the Years	2
Pest Recognition.....	4
Ways to Identify Pests	4
Characteristic Damage.....	5
Pest Management Methods	5
Biological Control.....	5
Chemical Control.....	6
Cultural Control.....	7
Genetic Control	8
Mechanical/Physical Control.....	8
Regulatory Control.....	9
Integrated Pest Management (IPM)	9
Why Practice IPM?	10
Components of IPM.....	10
Pest Population Thresholds	
Prevention	
Suppression	
Eradication	
Effectiveness of Pest Management Programs	13
Why Pesticide Applications Fail	13
Pesticide Resistance	
Summary	15
Review Questions.....	17
CHAPTER 2 FEDERAL PESTICIDE LAWS AND REGULATIONS	19
The Need for Regulation	19
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	20
Pesticide Registration	21
Tolerances	22
Pesticide Reregistration.....	23
Registration and Tolerance Reassessment.....	23

Violations and Federal Penalties	24
Penalties	24
Federal Pesticide Regulations under FIFRA	24
Pesticide Container and Containment Regulation (40 CFR Part 165)	24
Worker Protection Standard Regulation (40 CFR Part 170)	25
Certification of Pesticide Applicators Regulation (40 CFR Part 171)	25
Other Federal Laws	25
Federal Food, Drug, and Cosmetic Act	25
Food Quality Protection Act	25
Endangered Species Act	26
Federal Recordkeeping Requirements	26
Application Records	26
Training Records	27
Summary	27
Review Questions	29
CHAPTER 3 PESTICIDE LABELING	31
EPA Approval of Pesticide Labeling	32
The Label	32
Background of the Label	32
Toxicity and Toxicological Tests	
Efficacy or Performance Tests	
Degradation, Mobility, and Residue Tests	
Effects on Wildlife and the Environment	
Types of Pesticide Registration	33
When to Read the Pesticide Label	34
Parts of the Label	35
Trade, Brand, or Product Name	35
Ingredient Statement	35
Use Classification Statement	36
Type of Pesticide	36
Net Contents	36
Name and Address of Manufacturer	36
Emergency Telephone Number	36
Registration Numbers	36
Establishment Number	37
Signal Words and Symbols	37
Precautionary Statements	37
Routes of Entry Statements	
Specific Action Statements	
Protective Clothing and Equipment Statements	
Other Precautionary Statements	
First Aid Statements	39
Environmental Hazards	39
Special Toxicity Statements	
General Environmental Statements	
Physical or Chemical Hazards	40
Agricultural Use Requirements	40
Restricted-Entry Intervals	
Nonagricultural Use Requirements	41

Storage and Disposal	41
Directions for Use	41
Other Label Resources	41
Information Resources	41
World Wide Web References on Pesticide Labels	43
Digital Pesticide Specimen Labels	43
Electronic or Web-Distributed Labeling	43
Mandatory and Advisory Statements	43
Mandatory Statements	
Advisory Statements	
Understanding the Difference	
Safety Data Sheets	44
Summary	45
Review Questions	47
CHAPTER 4 PESTICIDE FORMULATIONS	49
Formulations: An Overview	50
Liquid Formulations	52
Emulsifiable Concentrates (EC or E)	52
Solutions (S)	53
Ready-to-Use (RTU) Low-Concentrate Solutions	
Concentrate Solutions (C, LC, or WSC/WSL)	
Liquid Baits	
Ultra-Low Volume (ULV)	54
Invert Emulsions	55
Flowables (F or AF)	55
Aerosols (A)	55
Ready-to-Use Aerosols	
Formulations for Smoke or Fog Generators	
Dry or Solid Formulations	56
Dusts (D)	56
Granules (G)	57
Pellets (P or PS)	58
Wettable Powders (WP or W)	58
Water-Dispersible Granules (WDG) or Dry Flowables (DF)	59
Soluble Powders (SP or WSP)	59
Baits (B)	60
Pastels, Gels, and Other Injectable Baits	
Other Formulations	61
Fumigants	61
Microencapsulated Pesticides (M)	61
Water-Soluble Packaging (WSB or WSP)	62
Impregnates	62
Animal Systemics	62
Pesticide-Fertilizer Combinations	62
Pesticide Mixtures	63
Adjuvants	63
Types of Adjuvants	64
Surfactants	64
Choosing the Right Adjuvant	65
Summary	66
Review Questions	67

CHAPTER 5 PESTICIDE HAZARDS AND FIRST AID	69
Toxicity, Exposure, and Hazard	70
Potential Harmful Effects of Pesticides	71
Exposure—How Pesticides Enter the Body	73
Skin or Dermal Route	73
Eyes or Ocular Route	74
Breathing or Inhalation Route	74
Swallowing or Oral Route	74
Product Toxicity and Health Concerns	74
Acute Toxicity	75
Signal Words and Skull & Crossbones Symbol	
Danger—Poison	
Danger	
Warning	
Caution	
Chronic Toxicity	78
Delayed Effects	79
Factors Affecting Response	79
Symptom Recognition	79
Cholinesterase Inhibition	80
Cholinesterase Monitoring	
First Aid for Pesticide Poisoning	81
General First Aid	81
Pesticide on the Skin	
Pesticide in the Eyes	
Inhaled Pesticide	
Pesticide in the Mouth or Swallowed	
How to Induce Vomiting (if appropriate)	
Antidotes	
Heat Stress	84
Symptoms of Heat Stress	84
Summary	85
Review Questions	87
CHAPTER 6 PERSONAL PROTECTIVE EQUIPMENT	89
Personal Protective Equipment	89
Good Work Practices	90
Protect Yourself from Pesticides	90
Protect Your Body	92
Work Clothing	92
Coveralls	92
Apron for Mixing	93
Headgear for Overhead Applications	93
Footwear	93
Gloves	94
Protect Your Eyes	95
Protect Your Respiratory System	96
Types of Respirators	97
Purifying Elements for Air-Purifying Respirators	97

Particulate Filters	
Chemical Cartridges or Canisters	
Combination Chemical Cartridge and Particulate Filters	
Identifying the Respirator Type from the Pesticide Label	99
Use Tight-Fitting Respirators Properly.	99
Maintaining Clothing and Personal Protective Equipment	100
Woven Work Clothes and Coveralls	100
Nonwoven Clothing.	101
Boots and Gloves	101
Eyewear and Respirators	101
Summary	102
Review Questions.	103
CHAPTER 7 PESTICIDES IN THE ENVIRONMENT	105
The Environment	105
Pesticide Characteristics	106
Solubility.	106
Adsorption	106
Persistence.	106
Pesticide Breakdown	
Volatility	107
How Pesticides Move in the Environment	107
Movement in Air.	107
Movement in Water	107
Movement on or in Objects, Plants, or Animals.	108
Preventing Pesticide Drift.	108
Spray Drift	108
Classification of Droplet Size	
Other Factors	
Temperature Inversions	
Vapor Drift	111
Particle Drift (Dust Drift)	111
Applicator Responsibility	111
Sources of Water Contamination	112
Pesticide Contamination of Surface Water	112
Pesticide Contamination of Groundwater.	113
Leaching	
Soil Properties	
Texture and Structure	
Organic Matter	
Depth to Groundwater	
Geology	
Preventing Surface Water and Groundwater Contamination	115
Use Integrated Pest Management Principles.	115
Identify Vulnerable Areas.	115
Do Not Mix and Load Near Water	115
Keep Pesticides Away from Wells	115
Avoid Back-Siphoning.	116
Improve Land Use and Application Methods	116
Time Pesticide Applications According to the Weather Forecast	116
Select Products Wisely.	116
Handle Pesticides Safely.	116

Preventing Harmful Effects on Sensitive Areas and Nontarget Organisms	117
Sensitive Areas	117
Pesticide Effects on Nontarget Organisms	117
Nontarget Plants	
Bees and Other Beneficial Insects	
Fish, Wildlife, and Livestock	
Protecting Endangered Species	119
Summary	120
Review Questions	121
CHAPTER 8 TRANSPORTATION, STORAGE, AND SECURITY ..	123
Transportation	123
Transport Vehicle	124
Vehicle Operator	124
Other Safety Precautions	125
Vehicle Placards	125
Storage of Pesticides in Buildings	126
Secure the Site	126
Prevent Water Damage	126
Control the Temperature	126
Provide Adequate Lighting	127
Use Nonporous Materials	127
Maintain the Storage Site	127
Keep Labels Legible	127
Store Pesticide Containers Safely	127
Look for Damage	128
Note Shelf Life of Pesticides	128
Follow These Safety Tips	128
Isolate Unwanted or Waste Products	128
Pesticide Site Security	129
Benefits of Security Efforts	129
Risk Assessment	129
Employee Training and Security Awareness	130
Evaluating Pesticide Security	130
Steps to Prevent Security Problems	130
Summary	131
Review Questions	133
CHAPTER 9 EMERGENCY OR INCIDENT RESPONSE	135
Emergency Response Planning	135
Fires	137
Precautions to Reduce Fire Hazards	137
Pesticide Spills	138
Control the Spill	138
Contain the Spill	139
Clean up the Spill	139
Prevent Spills	140
Summary	140
Review Questions	141

CHAPTER 10 PLANNING THE PESTICIDE APPLICATION . . . 143

Selecting the Pesticide	144
Reviewing the Pesticide Label	144
Determining Pesticide Compatibility	144
Conducting a Compatibility Test	145
Making Tank Mixes	
Following Safe Mixing and Loading Practices	146
Select an Appropriate Mixing and Loading Area	146
Protect Water Sources	147
Use Personal Protective Equipment	147
Opening Containers Carefully	147
Measure Accurately	148
Transferring Pesticides Carefully	148
Cleaning and Disposing of Pesticide Containers	148
Container Rinsing Procedures	149
Applying Pesticides Correctly	149
Personal Protective Equipment	149
Hand-Carried and Backpack Applications	
High-Exposure Applications	
Application Procedures	150
Cleaning up after Mixing, Loading, and Application	151
Cleaning Procedures	151
Rinsates	
Equipment Cleanup	
Professionalism	153
What is Professionalism?	153
Demonstrate Professional Ethical Standards	153
Communicate with Customers, Neighbors, and the Public	154
Summary	154
Review Questions	155

CHAPTER 11 PESTICIDE APPLICATION PROCEDURES . . . 157

Application Methods	157
Safety Systems	158
Closed Mixing and Loading Systems	158
Mechanical Systems	
Water-Soluble Packaging	
Enclosed Cabs	159
Pesticide Containment Systems	159
Application Equipment	160
Sprayers	160
Sprayer Components	161
Granular Applicators	162
Other Application Equipment	162
Equipment Calibration	163
Calculating Area	164
Rectangular Areas	164
Triangular Areas	164
Circular Areas	164

Calculating the Application Rate	165
Techniques to Minimize Drift	166
Summary	168
Review Questions	169

APPENDICES

A. Answers to Review Questions	171
B. Glossary	173
C. Conversions & Calculations	189
D. Safety Data Sheets	193
E. Selected Pesticide References	195
G. Pesticide-Related Resources	197