



Silent Spring

Rachel Carson

Teacher's Guide

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Synopsis

Chapter 1: A Fable for Tomorrow

An American town rich in plant and animal life thrived with families and farmsteads. Then the area suffered a blight that mysteriously killed cattle, sheep, and birds, and sickened people. The cause was self-poisoning.

Chapter 2: The Obligation to Endure

Living things function through interaction. Only in the twentieth century did humankind begin altering this web of life. Like radiation, a proliferation of biocidal chemicals allows users to kill insects. The result, as Darwin predicted, is a super race immune to poison. A side effect of tampering with nature is gene mutation, a shift in nature that could boomerang and destroy humankind. Citizens should be safe from lethal chemicals created by industrial greed and shielded by half-truths and lies.

Chapter 3: Elixirs of Death

All people come in contact with dangerous chemicals. They began in chemical warfare factories during World War II. Instead of arsenic, which has been banned, modern insecticides rely on chlorinated hydrocarbons like DDT, first synthesized in Germany in 1874. The body absorbs it from a variety of foods, including eggs and milk. Stored in body fat, the poison can cause degeneration of the liver. Chlordane can remain inert in the body and kill quickly or alter into heptachlor, which is four times as toxic. Dieldrin is five times as toxic as DDT and can destroy the nervous system when stress releases it from fat.

More mysterious is aldrin, which works on the liver and kidneys and causes sterility. The most toxic of chlorinated hydrocarbons is endrin, which is lethal to fish and birds. The most poisonous pest controls are alkyls, the

source of nerve gas. They destroy the enzyme cholinesterase, a natural protector of the body from toxins. Parathion, the most common of its class, kills bees and causes paralysis. Malathion, a common garden spray, is safe to the liver, but a combination with other poisons unleashes toxicity.

Chapter 4: Surface Waters and Underground Seas

Nothing in nature exists alone. Contaminants have entered water from nuclear explosions, radioactive waste, labs and hospitals, and various domestic and industrial sources. As groundwater seeps through porous rock and crevices, it travels underground and carries pollutants like the weed killer 2,4-D into springs and wells. From effluent chemicals, water-borne poisons form underground, and damage livestock and crops. When ingested by small organisms, poisons become concentrated and pass to predators. When these toxins reach humans, they can cause cancer.

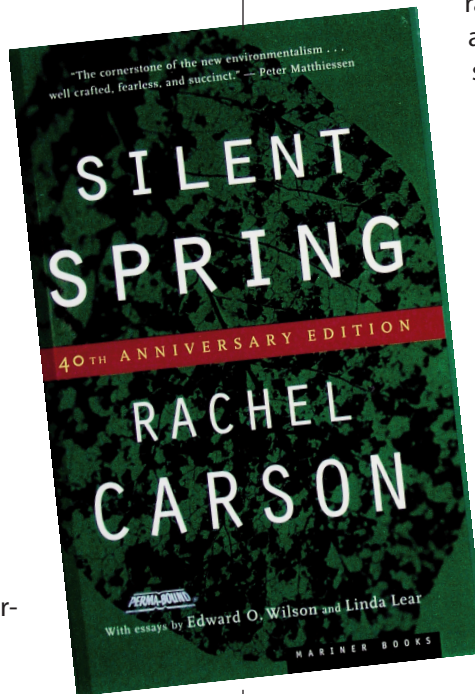
Chapter 5: Realms of the Soil

Soil is a thin layer covering the planet with life-supporting humus and minerals. Bacteria and fungi break down decaying matter, which earthworms aerate. Toxins

like 2,4-D halt the soil-enriching process. Other pesticides contaminate root crops like carrots and peanuts and create hazards in baby food.

Chapter 6: Earth's Green Mantle

Human life depends on plant life, which suffers from tampering caused by chemical sprays. When Western stock raisers killed off sagebrush to increase grass stands, they destroyed a web of life that depended on sage. Along with the sage went willows, moose, beaver, trout, waterfowl, and the beauty of the landscape. Tourism declined as the wilderness gave way to brown expanses. The loss of bees impacted crops that require pollination. Wildlife and domestic animals were drawn to the sweet flavor of plants poisoned with 2,4-D. The



release of nitrogen oxide in silos endangered farm workers. The convenience of poisons bypassed selective spraying and natural suppression of pests, such as the introduction of the Argentine moth to reduce cacti in Australia.

Chapter 7: Needless Havoc

Control agencies tend to deny loss of wildlife. The widespread spraying with aldrin to kill Japanese beetles in Detroit killed off birds, pets, and small animals. Symptoms appeared in humans. A cheaper and less harmful method of killing beetles involves spreading a milky spore that destroys grub worms before they become beetles.

Chapter 8: And No Birds Sing

A serious threat to songbirds occurred during civic attempts to halt Dutch elm disease, which destroyed shade trees. Studies linked the poisoning of earthworms with the sterility of birds and the deaths of nestlings. As a result, when the insects rebounded, there were fewer birds to suppress them. One victim was the American eagle. Another threat was seed with parathion, which felled workers who touched poisoned foliage.

Chapter 9: Rivers of Death

In New Brunswick, the poisoning of spruce budworms affected salmon and trout by killing off aquatic insects on which they feed. The same widespread death occurred in Maine, where game fish died in record numbers. In Alabama, spraying of cotton fields with toxaphene killed game and food fish. Toxins reached estuaries, threatening shrimp, oysters, and clams.

Chapter 10: Indiscriminately from the Skies

After World War II left a surplus of planes, aerial spraying became cheap and simple to operate. During the killing of the gypsy moth on Long Island, citizens sought injunctions against haphazard spraying by planes. The case advanced to the U.S. Supreme Court, but gained the concern of only one justice, William O. Douglas. Indiscriminate poisoning tainted truck garden crops and milk. After the lengthy program, the gypsy moth resurged in record numbers. A similar misguided attempt to control the fire ant in the South killed wildlife and poisoned cow's milk. An easier method of controlling the pest required only the destruction of individual ant mounds.

Chapter 11: Beyond the Dreams of the Borgias

Citizens are largely unaware of the shower of toxins, which derive from poisoned shelf paper, skin spray,

floor wax, and home insecticides. Tainted food cannot be washed clean. Cooking does not destroy residue. Even people living in northern Alaska are not completely free of contaminants. Poisons in warehouses soak through burlap bags and packages. Only those distributed across state lines come under federal scrutiny. Increasing the risk to consumers are tolerances—the allowance of low levels of toxins.

Chapter 12: The Human Price

Health problems from synthetic poisons afflict farmers, sprayers, pilots, and families. Signs of increased toxicity include hepatitis and cirrhosis of the liver, and disorders of the nervous system. Those most susceptible to toxins are women, children, and sedentary workers.

Chapter 13: Through a Narrow Window

The work of body cells in storing and using energy comes to a halt from radiation and chemical poisoning. Evidence of toxicity appears in the inability of animals to reproduce or in the sudden death of hatchlings. In mosquitoes, DDT causes freaks—part male, part female offspring. In humans, anomalies in blood chromosomes lead to genetic defects.

Chapter 14: One in Every Four

Carcinogens can derive from chemical toxins, such as the scrotal cancers in chimney sweeps from contact with heavy metals in soot. In addition to occupational hazards, all people, even the unborn, face risks of malignancy in lymph and blood-forming tissue. Like the natural arsenic that endangers mammalian life in Silesia, synthetic toxins cause malignancies to form in humans. The theory of Otto Warburg explains why low dosages of carcinogens are more dangerous than a single mass poisoning. Because the world teems with carcinogens, a panacea to cure cancer is unlikely. A more practical assurance of health is a reduction in synthetic poisons.

Chapter 15: Nature Fights Back

Insects are developing strains resistant to poisons. Those habitats that experience the eradication of one species overproduce the life forms on which the missing species once fed. Thus, nature struggles to maintain a balance.

Chapter 16: The Rumbblings of an Avalanche

The results of synthetic chemical spraying support Darwin's theories about survival of the fittest. For example, the emergence of resistant species increased the malaria-bearing *Anopheles* mosquito and transmitters of yellow fever, dysentery, typhus, and encephalitis.

Humans could also develop resistance, but the shielding of the race from poisons might take millennia.

Chapter 17: The Other Road

Humanity is not condemned to creating poisons to control pests. Some alternatives to chemical poisons involve mass sterilization of insects such as screw-worms. Another method is mutation or interruption of the insect's life processes.

Author Sketch

Called “the patron saint of the environmental movement,” scientist and writer Rachel Carson almost single-handedly sparked the movement in the early 1960s through her writings and advocacy efforts. Her work alerted consumers, scientists, and policymakers to the widespread and cumulative effects of pollution and ecological mismanagement. Born on a farm in Springdale, Pennsylvania, on May 27, 1907, she was the youngest of the three children of author Maria McLean and farmer Robert Warden Carson. Carson's mother taught her and her siblings to love and study nature, and Carson spent many childhood hours exploring the outdoors. She began her scholarly career in 1917 with publication in a children's magazine. Beginning as a student of English at Pennsylvania College for Women (now Chatham University), she soon switched majors, concentrating in zoology and genetics.



Although she earned a master's degree from Johns Hopkins University, she had to abandon her dream of earning a doctorate after her father's death in 1935, when she was forced to seek full-time employment to help support her aging mother and orphaned nephews. She taught at Johns Hopkins and the University of Maryland, and worked as a biologist for the U.S. Bureau of Fisheries (she was only the second woman to be hired by the agency to a full-time, professional position). While at the Bureau, she wrote scripts for radio broadcasts, as well as features on the biota of the Chesapeake Bay for the Baltimore *Sun*. By 1936, she was editor in chief for federal wildlife publications. In the 1950s, she became a full-time nature writer.

Carson focused on the fragility and interconnectedness of life on earth; she protested against pollution and its ultimate destructive effects on mankind. She developed

the article “Undersea” (1937), published in *Atlantic Monthly*, into *Under the Sea-Wind* (1941), and pitched her tone and diction at the ordinary reader. During the post-World War II boom in chemical engineering, her writing turned more toward protecting the Earth from death-dealing pollutants. The best-selling *The Sea Around Us* (1951), serialized in the *New Yorker*, earned her financial freedom; she followed it with *The Edge of the Sea* (1955). In the next two years, she issued “Help Your Child to Wonder” and “A Sense of Wonder,” essays for *Woman's Home Companion* that linked nature with the healing and comfort of the soul.

In the tenth year of her career as a naturalist author, Carson produced her most influential work, *Silent Spring* (1962), an urgent alarm about the poisoning of plant and animal life. The simple but learned text charged industry and individuals with the foolhardy endangerment of nature, and ultimately, humanity. She backed up her concerns with a fifty-five-page source list. A CBS television series in 1963 featured her research. She continued to promote a global effort to curtail deadly practices that threatened life on the planet, even as she herself fought a losing battle against breast cancer. At her death in Silver Spring, Maryland, on April 14, 1964, her manuscripts and papers passed to Yale's Beinecke Rare Book and Manuscript Library. A nature trail in Wells, Maine, honors her name and work.

Critic's Corner

Carson was a marine biologist and writer whose works are often credited with launching the worldwide environmental movement. Designated one of the 100 most important activists of the twentieth century, Carson spurred a revolution in nature philosophy and in concern for sustainable habitats and human health. She likened the danger of biocides to that of atomic power, and warned, “We have now acquired a fateful power to alter and destroy nature.” Although she focused on the place of humankind in the natural world, her opponents depicted her as a hysterical Cassandra. Her accusations resulted in rebuttals and threats of legal action from chemical firms and ridicule from the Monsanto Company, but she continued to address issues of corporate greed. Despite vocal critics, her views gained widespread and influential support, including that of Supreme Court Justice William O. Douglas, President John F. Kennedy, and the National Science Advisory Committee. Her writings led to a reversal in pesticide policy in the United States, including the 1963 ban on DDT (which had been in use since 1942) and several

other pesticides. The grassroots environmental movement sparked by her writings and other efforts led to the creation of the Environmental Protection Agency.

Carson's works struck home with readers, who kept *The Sea Around Us* on the bestseller list for eighty-six weeks, and fueled translations into thirty languages. Named one of the ten books that changed the world, *Silent Spring* broke sales records before its release and thrived in the United States and Great Britain. The author earned the Audubon Medal, a National Book Award, a Guggenheim fellowship, medals from the New York Zoological Society and the Geographical Society of Philadelphia, a John Burroughs Medal, and a posthumous Presidential Medal of Freedom. In 2002, Chickasaw poet Linda Hogan and Brenda Peterson honored Carson's role in ecofeminism in *The Sweet Breathing of Plants: Women Writing on the Green World* (2002), a compendium featuring Carson's prose.

Other Works by Rachel Carson

Under the Sea-Wind, 1941

Food from the Sea: Fish and Shellfish of New England, 1943

Food from the Sea: Fish and Shellfish of the South Atlantic, 1944

The Sea Around Us, 1951

The Edge of the Sea, 1955

Silent Spring, 1963

The Sense of Wonder, 1965

Always, Rachel: The Letters of Rachel Carson and Dorothy Freeman, 1952-1964, 1995

Lost Woods: The Discovered Writing of Rachel Carson, 1998

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Bekoff, Marc, and Jan Nystrom. "The Other Side of Silence: Rachel Carson's Views of Animals," *Zygon* 39, no. 4: 861-883.

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Lougheed, Tim. *Pollution A to Z*. New York: Macmillan, 2004.

Murphy, Priscilla Coit. *What a Book Can Do*. University of Massachusetts Press, 2005.

Quaratiello, Arlene R. *Rachel Carson: A Biography*. Westport, Mass.: Greenwood, 2004.

"Rachel Carson Dies of Cancer," *New York Times* (15 April 1964).

Seager, Joni. "Rachel Carson Died of Breast Cancer: The Coming Age of Environmentalism," *Signs: Journal of Women in Culture and Society* 28, no. 3 (spring 2003): 945-973.

Smith, M. B. "Silence, Miss Carson: Science, Gender, and the Reception of Silent Spring," *Feminist Studies* 27, no. 3 (fall 2001): 733-752.

Waddell, Craig, ed. *And No Birds Sing: Rhetorical Analyses of Rachel Silent Spring*. Carbondale: Southern Illinois University Press, 2000.

Silent Spring Timeline

- 1775** Sir Percivall Pott identified the cause of scrotal cancer in chimney sweeps.
- 1787** Arthur Philip introduced cacti in Australia.
- 1793** St. Johnswort first appeared in the United States.
- 1874** German chemists first synthesized DDT.
- 1883** Darwin published *The Formation of Vegetable Mould Through the Action of Worms*.
- 1911** The gypsy moth was introduced in New Jersey from Holland.
- 1916** Japanese beetles appeared in the United States in Riverton, New Jersey.
- 1930** Argentine moths suppressed the prickly pear in Australia.
Dutch elm disease reached the United States from Europe.
- 1933** Milky spore disease began killing Japanese beetles.
- 1938** A hurricane carried the gypsy moth to Pennsylvania and New York.
- 1942** Wilhelm Hueper published *Occupational Tumors*.
- 1943** The Rocky Mountain Arsenal of the Army Chemical Corps made weapons that poisoned groundwater.
- 1944** Beetles from France controlled St. Johnswort in the United States.
- ca. 1945** Some 200 chemicals were created to kill pests.
- 1947** American eagles began to decline in number.
- late 1940s** Chemical poisons were being manufactured in large quantities.
- 1951** English farmers used arsenic to burn off potato vines.
- 1950s** The Dutch discovered that polluted

- water carries carcinogens.
- 1954** Spraying for Dutch elm disease began killing birds.
Spraying for spruce budworm killed salmon in New Brunswick.
- 1957** Long Islanders sought an injunction against spraying for gypsy moths.
- 1958** Spraying for forest insects in Maine killed fish.
The American Society of Ichthyologists and Herpetologists asked the Department of Agriculture and state agencies to stop spraying poisons.
- 1959** The English chemical firms stopped producing arsenic sprays.
Chemical treatment of farmland doubled over the past decade.
The California Department of Public Health stopped poisoning Clear Lake.
The Food and Drug Administration banned heptachlor on food.
- fall** State and federal authorities dusted Detroit, Michigan, with aldrin to control Japanese beetles.
- 1960** The U.S. Fish and Wildlife Service found insecticides stored in the fat of wild animals.
Every wild mammal suffered loss from DDT.
Insects developed an alarming resistance to chemical suppressants.
- summer** Birds died at Tule Lake and Lower Klamath, California, from poisoned plankton.
- 1961** Australia banned arsenic sprays.
- Jan. 15** Fish died in the Colorado River below Austin, Texas.
- 1962** The fire ant eradication program is declared a failure.

Across the Curriculum

Art

1. Make an illustrated notebook of pests in nature. Include insects and animals that carry lethal diseases like typhus, plague, tetanus, encephalitis, Rocky Mountain spotted fever, lassa fever, leptosporosis, dysentery, bird flu, West Nile fever, anthrax, machupo virus, marburg virus, polio, brucellosis, yellow fever,

chagas, cholera, dengue fever, dracunculiasis, leishmaniasis, trachoma, ebola, elephantiasis, yaws, ergotism, tetanus, typhoid fever, E coli, giardiasis, glanders, hantavirus, hepatitis, psittacosis, hookworm, lyme disease, onchocerciasis, Q fever, tularemia, schistosomiasis, papataci fever, scabies, shigellosis, and malaria. Next to each pest, sketch the microbe that causes each disease.

Law

1. Read aloud state laws governing the use of chemical poisons on dairy, poultry, and truck farms. Contrast those laws with the stringency of federal laws.
2. Make a chart of cases concerning chlorinated hydrocarbon poisoning that have reached the U.S. Supreme Court. Determine which judgments have been far-reaching and which too weak to protect citizens.
3. Debate whether environmental laws should protect special interest groups, such as duck and deer hunters, trout and salmon fishers, wildflower growers, tourists, bicyclers, shell and butterfly collectors, off-road vehicle enthusiasts, hang gliders, or bird and whale watchers.

Religion

1. Compose an extended definition of animism. Explain in an oral report why Native American respect for nature protected wildlife until the arrival of European explorers and colonists.

Drama

1. Draw stage settings for a dramatization of rescuing a home garden from an aerial sprayer, locating a fish-kill on the Colorado River, banding American eagles, or studying dead robins and earthworms for evidence of synthetic poisons. Comment on the tendency of humans to disregard threats to the food chain.
2. Create a storyboard account of the Long Island citizen injunction against aerial spraying of gypsy moths. Conclude with the summation of the New York State Supreme Court and the dismissal of the U.S. Supreme Court.

Education

1. Role-play the part of an entomologist, ichthyologist, or field biologist in northern Alaska. Outline ways of determining whether life above the Arctic Circle is safer from carcinogens than in New Brunswick, Alabama, Detroit, Maine, Silesia, Holland, Australia, or Clear Lake and Lower Klamath, California.
2. Propose curriculum for a night class to teach farm laborers about workers' rights. Include ways to avoid lethal spray residues and dust on plants, carcinogens in the workplace, polluted water, and the handling of synthetic poisons controlling fire ants, screwworms, gypsy moths, Mediterranean fruit flies, and Japanese beetles. Suggest federal agencies that test for poisons in the adipose tissue of humans.

Speech

1. Organize a discussion of the role of chemical manufacturers in the dissemination of lies and concealed data concerning the dangers of pesticides. Propose local intervention on behalf of women, children, the unborn, and people with impaired immune systems. Include pro bono legal advice, wellness counselors, and financial aid for those who need extensive medical tests and detoxification.
2. Outline an address to gardeners on harmless methods of suppressing pests; for example, planting marigolds to halt nematodes, building martin houses, fostering bats and toads to eat mosquitoes, spreading diatomaceous earth in gardens, or distributing milky spore bacilli to kill Japanese beetle grub worms.

Cinema

1. View films with urban settings and situations growing out of environmental issues, such as *Combustion*, *Andromeda Strain*, *Silkwood*, *Outbreak*, *Erin Brokovich*, and *Ecology of the Galapagos*. Compare the movies' settings, themes, and historical background to those of *Silent Spring*. Comment on the interplay of people of different ethnic, social, political, educational, and professional backgrounds, particularly commercial fishers, farm workers, biologists, consumers, hikers, bird watchers, parents, physicians, and Food and Drug

Administration agents.

Science and Health

1. Compose a lecture on the hazards of handling liquid pesticides and herbicides. List first aid, complications, and treatment for workplace and home ailments, especially those involving blurred vision, nausea, rash, headaches, tremors, respiratory arrest, and convulsions. Discuss the importance of clean food, water, and air to human survival and productivity.
2. Summarize the work of the Occupational Safety and Health Administration (OSHA). Discuss innovations and technology that relieve laborers of workplace danger. List masks, hazmat suits, air purification systems, goggles, impermeable gloves and boots, robotic handling of poisons, and showers to wash off toxic chemicals. Explain why long-term planning and worker education prevent accidents and work-related illness and the birth of malformed children.
3. Compose a theme on Rachel Carson's contributions to the health of the planet. Explain the value of her training and writing skills in alerting Americans to the dangers from garden sprays and dusts.
4. Compose an encyclopedia entry explaining the Warburg theory of carcinogens or Charles Darwin's theory of survival of the fittest.

Social Studies and Economics

1. Divide the class into small groups to brainstorm ways to improve community relations after a pollutant has spread illness—for example, water-borne pathogens following a hurricane, a toxic spill on the highway or railroad, or contamination of wells by chemical factories. Include activities that enable citizens to make their case to government agencies, particularly the Department of Agriculture and the Environmental Protection Agency. List ways of suppressing citizen discontent and of promoting fair treatment and environment cleanup.
2. Compose an extended definition of carbonated hydrocarbons. Using a flow chart, explain why they are profitable to companies like

Monsanto and why profits tend to override concerns for the environment and for human health.

Psychology

1. Describe aloud the drive for a better life. Explain why homeowners go to great lengths to create a smooth green lawn and an insect-free kitchen and patio.
2. Using incidents from the book, comment on gradual changes in the public perception of chemical poisons. Discuss how Rachel Carson coped with repeated disillusion and with refutation of scientific data by profiteers and misogynists.

Mathematics and Computers

1. Design a website or bulletin board that identifies these terms: microbes, selenium, macerate, arsenic, pyrethrum, inert, antimalarial, ephemeral, contingency, pathogen, organic, lichen, ensiled, dispersion, watershed, biopsy, remiss, carcinogenic, neurological, sanctuary, estuary, nematode, placenta, degenerative, indiscriminately, placenta, excreted, cumulative, regressive, tolerance, toxicity, inorganic, unpalatable, entomologist, irrecoverable, alchemy, larval, synthetic, heavy metal, and nitrogen-fixing.
2. Based on your understanding of the book, lead a panel discussion of the effects of imbalance in local animal and insect populations, such as influxes of fire ants or rodents. Support your opinions with facts from health reports, biological and habitat surveys, and statistics from almanacs and environmental studies.

Language and Speech

1. Create a chart to accompany a speech about deadly synthetic poisons. Include DDT, heptachlor, chlordane, aldrin, endrin, toxaphene, schraden, benzene hexachloride, malathion, parathion, and 2,4-D. Compare their effects on animal and plant life. Include data on threats to fish, bird, and mammalian health.
2. With a partner, role-play a dialogue dramatizing Rachel Carson's comments on the value of natural suppression of pests; for example, the use of natural predators to control the gypsy

moth, Japanese beetle, spruce budworm, crabgrass, and nematode.

3. Summarize aloud a chapter of a classic ecofeminist work, such as *Prodigal Summer*, *Women Who Run with the Wolves*, *Herland*, *The Country of the Pointed Firs*, *Woman on the Edge of Time*, *Animal Dreams*, *The Sweet Breathing of Plants*, *Last Stand: America's Virgin Lands*, *The Everglades: River of Grass*, *The Land of Little Rain*, or *Where Late the Sweet Birds Sang*.
4. Explain in a brief speech how deniers of Carson's claims used sexism and character assassination to discredit her research.

Literature and Composition

1. Comment in an essay on Rachel Carson's citation of Jean Rostand's claim, "The obligation to endure gives us the right to know."
2. Explain in an essay the significance of the title *Silent Spring*, particularly as it applies to the permanent loss of songbirds. Propose other titles that express Rachel Carson's ecological principles, such as "Rivers of Death" and "Nature Fights Back."
3. Write an essay in which you explain the role of a single species, such as the shrimp, plankton, grackle, grebe, ground squirrel, flycatcher, robin, earthworm, Mediterranean fruit fly, salmon, mayfly, shrew, or woodcock. Determine how the loss of one element of nature creates chaos in the web of life.
4. Outline a report to Congress on threats to ecology in your area. Consider polluted runoff from city streets, factory emissions, sewage leaks, roadside trash, or toxic waste at a landfill.

Related Reading

Mary Hunter Austin, *The Land of Little Rain* and *Stories from the Country of Lost Borders*
 Eavan Boland, "The Making of an Irish Goddess"
 Willa Cather, *O! Pioneers*
 Jacques Cousteau, *The Silent World*
 Marjory Stoneman Douglas, *The Everglades: River of Grass*
 Charlotte Perkins Gilman, *Herland*
 Joy Harjo, "Eagle Poem"

Linda Hogan and Brenda Peterson, *The Sweet Breathing of Plants*
Gerard Manley Hopkins, "Inversnaid"
Sarah Orne Jewett, *A White Heron and Other Stories*
Barbara Kingsolver, *Animal Dreams, Last Stand: America's Virgin Lands, and Prodigal Summer*
Ursula Le Guin, *Earthsea* series
John Muir, *The Mountains of California*
Marge Piercy, *Woman on the Edge of Time*
Marjorie Kinnan Rawlings, *Cross Creek*
Kate Wilhelm, *Where Late the Sweet Birds Sang*

Literary Terms and Applications

For a better understanding of Rachel Carson's *Silent Spring*, present the following terms and applications:

Fable: a brief, elementary moral story in verse or prose that expresses some human foible or shortcoming. As though teaching children a simple lesson, Rachel Carson opens *Silent Spring* with the tale of a pleasant environment that humans ruin. The specter of permanent loss of plants and animals and the compromising of human health warns readers of the seriousness of her text. The fable also validates Carson's intent to teach rather than accuse.

Investigative research: literature comprising factual writing exposing a situation or topic of general interest, such as Upton Sinclair's *The Jungle* (1906), Margaret Mead's *Coming of Age in Samoa* (1928), and Barbara Ehrenreich's *Nickel and Dimed* (2001). *Silent Spring* speaks in ordinary language the author's purpose, scientific methodology, and summation of the dangers of pesticides to life on earth. By examining air, water, soil, and flora and fauna, Carson moves directly to the effects on human life and the danger of destroying the planet as a habitat capable of supporting life.

The Importance of Setting

The milieu of *Silent Spring* moves from habitat to habitat to describe evidence of pollution, gene mutation, and the spread of carcinogens. Beginning with a fable about a blighted American town, she refers to chemical warfare factories during World War II that launched modern insecticides like DDT and other chlorinated hydrocarbons. She refers to the poisoning of Lower Klamath, California, and to Western stock raisers who killed off sagebrush to increase grass stands. As a result, they destroyed the web of life that depended on sage. The peripheral damage caused depletion of willows, moose, beaver, trout, waterfowl, and natural beauty, and destroyed tourism and sport fishing. The extermination of bees impacted agricultural crops that required polli-

nation. Gradually, toxins afflicted wild and domestic animals and endangered farm workers. As a contrast to indiscriminate poisons, she describes the introduction of the Argentine moth in Australia that reduced an abundance of prickly pear and to the use of marigolds to suppress nematodes.

Carson continues alternating between scientific theory and case histories. She returns to American settings to outline the widespread spraying with aldrin to kill Japanese beetles in greater Detroit and fire ants in Florida and the lower South. As a result of the aerial spread of toxins and of toxic drift, birds, pets, and small animals died and humans began experiencing life-threatening symptoms. Another American travesty was the attempt to halt Dutch elm disease in urban areas. From the over-application of organic compounds came the poisoning of earthworms and the sterility of songbirds, a major threat to the stability of the environment.

Additional examples bring the problem of synthetic poisons to the American table. In New Brunswick, the poisoning of spruce budworm killed the aquatic insects that fed salmon and trout, two species that provide recreational fishing as well as food fish. Similarly, in Maine, widespread spraying caused extensive deaths of game fish. In Alabama, toxaphene sprayed on cotton fields poisoned groundwater and killed game and food fish. As the toxins flowed toward the sea, estuaries rich in shrimp, oysters, and clams suffered a similar loss of diversity. Her models imply that humankind is careless with its most precious resources.

Cross-Curricular Sources

For more information about pesticides, the environment, workplace hazards, worker endangerment, ecological testing, diversity in nature, cancer and genetic mutation, fragile habitats, and other subjects and issues deriving from Rachel Carson's exposé, consult these sources:

Articles

Aay, Henry. "Environmental Themes in Ecofiction: In the Center of the Nation and Animal Dreams," *Journal of Cultural Geography* 14, no. 2, (spring/summer 1994): 65-85.

Cone, Marla. "The Unbroken Chain," *Columbia Journalism Review* (1 July 2005): 65-68.

Karaim, Reed. "Not So Fast with the DDT," *American Scholar* 74, no. 3 (summer 2005): 53-59.
Audiocassette

“Workplace Bugs, Plants, and Animals Can Make You Sick,” National Safety Council

Books

Animal Dreams, Barbara Kingsolver
The Everglades: River of Grass, Marjory Stoneman Douglas
Humanly Possible, Jean Rostand
The Jungle, Upton Sinclair
The Land of Little Rain, Mary Hunter Austin
Prodigal Summer, Barbara Kingsolver
Woman on the Edge of Time, Marge Piercy

Essays

Beyond Borders, Mary Hunter Austin
The Sweet Breathing of Plants, Linda Hogan and Brenda Peterson

Film/Video

Andromeda Strain
Combustion
Erin Brockovich
Harvest of Shame
On the Beach
Outbreak
Silkwood

Internet

“Carcinogens,”
<http://www.osha.gov/SLTC/carcinogens/index.html>.
 “PAN Pesticides Database,”
<http://www.pesticideinfo.org/Index.html>.
 “Rachel Carson: A Scientist Alerts the Public to the Hazards of Pesticides,”
<http://onlineethics.org/moral/carson/index.html>.
 “U.S. Environmental Protection Agency: History,”
<http://www.epa.gov/history/timeline/index.htm>

Poems

“Birdfoot’s Grandpa,” by Joseph Bruchac
 “Eagle Poem,” by Joy Harjo
 “Inversnaid,” by Gerard Manley Hopkins

Reference Books

And No Birds Sing, Southern Illinois University Press
Eagle Man: Charles L. Broyley’s Field Adventures with American Eagles, Pellegrinin & Cudahy
Five Past Midnight in Bhopal, Warner
Our Children’s Toxic Legacy, Yale University Press
World Epidemics, McFarland
World Shores and Beaches, McFarland

Themes and Motifs

A study of the central issues and situations in Silent Spring should include these aspects:

Themes

- scientific innovation
- nature
- interdependence
- poison
- safety
- exploitation
- greed
- pragmatism

Motifs

- coping with foolhardy commercialism
- understanding the web of life
- assuming responsibility for nature
- comprehending carcinogens and on-the-job hazards
- accounting for the ecology movement

Objectives

General Objectives

1. To understand the impact of biocides on life
2. To account for wasteful methods of pest control
3. To interpret attitudes toward nature
4. To establish causes of water pollution
5. To discuss the methods of collective action and court injunctions
6. To explain cell biology
7. To analyze the threat of pesticides to national health
8. To describe attitudes toward earth guardianship
9. To describe rhetorical elements that alert and inform readers
10. To analyze the role of greed in causing extermination of species and landscape blight

Specific Objectives

1. To explain how World War II impacted the chemical industry
2. To analyze the symbolism of the title
3. To summarize the outcomes of Rachel Carson’s warning
4. To account for deaths of fish, birds, and earthworms
5. To justify the control of the Japanese beetle, gypsy moth, and spruce budworm
6. To predict how chemical residues will continue to impact human health

7. To summarize Carson's exposé of ecological and safety infractions
8. To discuss the implications of insect resurgence after spraying
9. To describe the roles of the Department of Agriculture and the Food and Drug Administration
10. To list reasons to ban indiscriminate aerial spraying

Other Versions of Carson's Work

Audio Cassette (abridged)

Silent Spring, DH Audio, 1999

Audio Cassette (unabridged)

Silent Spring, DH Audio, 1986

Film

Rachel Carson's Silent Spring, Peace River Films, 1993

Large Print

Silent Spring, G. K. Hall, 1997

Comprehension Study

Answer the following questions in your own words. There is not always a right answer. Your judgment is important and you should be ready to defend your answers with quotations from Rachel Carson's text.

Historical Milieu

1. How did World War II affect the pesticide industry?
(The creation of nerve gas and chemical warfare agents during the early 1940s introduced toxic substances that also had peacetime uses. From these poisons came DDT, a popular spray to halt mosquitoes and other flying pests that carry malaria and other diseases. As a method of dispersal, the large surplus of planes after the war carried dusts and sprays over wide expanses of land.)

Setting

2. Describe the habitat of Carson's introductory fable.
(Carson introduces Silent Spring with a fable set in an Edenic American town. Harmonious and prosperous, town and nearby farms profited from fruit and shade trees, forests, and small animals. In addition to commercial plants, the countryside produced beauty from winter birds and spring migrants. Streams provided trout for

sport fishing. Human inhabitants enjoyed the outdoors.)

Development

3. How does Carson's text expose carcinogens?
(Carson builds her case against biocides by describing the indiscriminate poisoning of habitats to control a single pest, such as the gypsy moth, prickly pear, sage, spruce budworm, screwworm, Mediterranean fruit fly, or Japanese beetle. By picturing the death throes of earthworms, fish, birds, and small mammals, she achieves the credibility of an eye witness. To impress the reader with personal liability, Carson moves on to cell biology and the storing of carcinogens in the body's adipose tissue. By accounting for cancers derived from internal toxins, she alerts the public to the danger of pesticides to all living beings, including humankind.)

Motivation

4. What is the purpose of the Food and Drug Administration?
(Carson indirectly lauds federal supervision of toxins in food and water. By describing how cows ingest poisoned grain and water, she explains the need for surveys of milk and dairy products, particularly butter, which concentrates toxins. The same implications apply to eggs, fruits, and vegetables, which store contaminants in their tissues. She explains that the Food and Drug Administration coordinates surveillance over interstate commerce, particularly foods too tainted for human consumption. By justifying the work of a regulatory agency, she makes her case for increased testing of foods to rid baby food and the rest of the American diet of toxins.)

Theme

5. Why does Carson stress the role of corporate greed in the poisoning of the planet?
(Carson explains to the unsuspecting home gardener the boomerang effect of dispersing pesticides in the yard and home. She cites Darwin's theory of survival of the fittest to account for the resurgence of insect populations after the suppression of the weakest organisms. Worsening the situation is the extermination of birds, which provide natural insect control. By accounting for the built-in need for more pesti-

cides, she charges pesticide makers with deliberately creating a market for lethal products.)

Interpretation

6. How can pollution endanger earth?

(Because pollutants tend to spread through air and groundwater and concentrate in organisms, they taint the entire food chain. The toxicity of inorganic chemicals spreads from simple plankton to giant trees and the creatures of earth, sea, and air. Carson stresses that, without an antidote to widespread contamination, poisonous chemical residues will remain toxic and death-dealing. She predicts that, when too much of the earth's surface is poisoned, humankind will no longer survive.)

Conflict

7. Why did Carson encounter disbelief?

(Carson's theories are complex and all-encompassing. When deniers read her text, they accused her of being the hysterical Jeremiah predicting doom without substantiation. Because of a growing backlash against the chemical industry, Carson garnered grassroots support that pressured President John F. Kennedy and the U.S. Congress to examine her charges and determine how close she came to envisioning a future disaster. Her skill at marshalling scientific evidence and building her case against pesticides gradually wore down selfish corporate support and replaced it with a genuine interest in preserving life forms.)

Atmosphere

8. How does the introductory fable establish tone and atmosphere?

(By creating a fictional American community that thrived in a healthy habitat, Carson drew on the American dream and normal yearnings for a safe, family-friendly environment. When she introduced the creeping blight that destroys domestic harmony, she established the insidious nature of gradual tainting of air, land, and water. By describing the deaths of domestic animals, she summoned doubt that the food chain is clean enough for human consumption. Her image of children dying after play enhanced the notion that the most innocent of human experiences could lead to sudden illness and death. With simple directness, she concludes, "The people had done it themselves.")

Author Purpose

9. Why did Rachel Carson spend her last days informing Americans of danger to the environment?

(As her own body sickened from breast cancer, Carson had an altruistic purpose in organizing an impressive array of scientific evidence that the planet is in danger of irreversible pollution. At the beginning of chapter 17, she described the state of affairs as an image from Robert Frost's familiar poem "The Road Not Taken." By picturing a fork in the road, she reassured readers that wiser choices of pest control were available and could reverse the rush toward chemical poisoning. In the final paragraph, she described the will to control nature as human arrogance, a throwback to primitive science and the philosophy that the earth exists solely for human convenience.)

Style

10. How does Rachel Carson balance her scientific and rhetorical skills?

(A gifted writer and researcher, Carson harnesses one skill in service to the other. By writing at a readable level with ordinary diction, she creates scenarios that untrained readers can understand. By referring to such dangers as concentrated toxins in butter and the destruction of sport fishing and tourism, she implies a multi-stage disaster that could wipe out food supplies at the same time that it threatened forms of relaxation and the economy. These details activate danger signals in ordinary readers, warning them that their lives and their children's future are at stake.)

How Language Works

To enlighten without terrifying, Rachel Carson controls tone and image to sustain reader interest:

1. Carson balances fearful examples with subtle warnings: "The reproductive capacity of the birds has been so lowered by some environmental agents that there are now almost no annual additions of young to maintain the race."
2. She admits to the limitations of science: "Here and there, in research widely scattered and sometimes not undertaken as a cancer study at all, we see glimmerings of the first light"

that may one day illuminate the problem.”

3. Carson elucidates human foibles without seeming superior: “The trouble is that we are seldom aware of the protection afforded by natural enemies until it fails.”
4. The author projects a mystic, reverent view of the natural world: “Most of us walk unseeing through the world, unaware alike of its beauties, its wonders, and the strange and sometimes terrible intensity of the lives that are being lived about us.”
5. In the final paragraphs, Carson describes a small advance—the introduction of shrews in Newfoundland to control sawflies. Her example leads to a satisfying conclusion: “There is, then, a whole battery of armaments available to the forester who is willing to look for permanent solutions that preserve and strengthen the natural relations in the forest.”

Meaning Study

Below are significant words, phrases, or sentences from the book. Explain each in context. Chapter and page numbers pinpoint each entry so that you can re-read the passage in which it appears.

1. During the Cretaceous Period, some hundred million years ago, flooding seas cut many land bridges between continents and living things found themselves confined in what Elton calls “colossal separate nature reserves.” (pp. 10-11)
(During the Cretaceous Period, which occurred 65-144 million years ago, the world-continent Pangaea began to separate into smaller land masses. The flora and fauna isolated in Australia, Africa, Iceland, Greenland, Eurasia, and the Americas evolved in limited habitats and produced unique characteristics, such as the koala bear and kangaroo in Australia and giraffes in Africa. At the end of the period, massive animal extinctions killed off dinosaurs.)
2. If the Bill of Rights contains no guarantee that a citizen shall be secure against lethal poisons distributed either by private individuals or by public officials, it is surely only because our forefathers, despite their considerable wisdom and foresight, could conceive of no such problem. (pp. 12-13)

(Carson links the poisoning of the earth to the guarantees of the Bill of Rights and proposes that citizens consider the problem from the aspect of civil rights. Her reasoning applies to a variety of scientific innovations, particularly radiation, in vitro fertilization, human-to-human and animal-to-human organ transplant, and weapons of mass destruction. All lay outside the understanding, experience, and anticipation of the founders of American democracy.)

3. This industry is a child of the Second World War. (p. 16)
(During World War II, chemical engineering put new demands on synthesizers of necessary substances. German laboratories produced more lethal poisons for the purpose of exterminating prisoners of war and killing the body lice that cause typhus. Worldwide, the disruption of supply lines required the synthesis of necessary resources, for example, quinine for the control of malaria and vitamins for the supplementing of limited diets.)
4. Since many of its compounds are tasteless, it has been a favorite agent of homicide from long before the time of the Borgias to the present. (p. 17)
(The Borgias of Italy brought ignominy on their dynasty for their ruthless grasp on power and wealth. One daughter, Lucrezia (1480-1519), was reputedly the cause of selective poisonings with cantarella, arsenic, and aconite (also wolfsbane or monkshood), a plant that produces a toxic alkaloid that was once prized for the tips of arrows. Historians refute much of the Borgia legend.)
5. Because these small amounts of pesticides are cumulatively stored and only slowly excreted, the threat of chronic poisoning and degenerative changes of the liver and other organs is very real. (p. 22)
(The body's largest internal gland, the liver, is a spongy tissue mass that cleanses the bloodstream of poisons and waste, some formed by the body itself. Without purification, the body would soon sicken and die from overwhelming toxicity.)
6. The second major group of insecticides, the alkyl

or organic phosphates, are among the most poisonous chemicals in the world. (p. 27)
(The alkyls are effective poisons because they suppress cholinesterase, a natural enzyme that prevents toxic buildup in the body. Because alkyls quickly paralyze the muscles, constrict the throat, and stop respiration, they are ideal choices for chemical warfare.)

7. In Greek mythology the sorceress Medea, enraged at being supplanted by a rival for the affections of her husband Jason, presented the new bride with a robe possessing magic properties. (p. 32)
(For her cunning and guile, Medea is the closest thing to a witch in classical myth. Consumed by passion and jealousy, she decided to murder Jason's new wife Glauce, a royal princess of Corinth. In the version by tragedian Euripides, Medea's gift of a coronet and robe conceals a poison that bursts into flames and burns Glauce to the bone. The poison spreads to King Creon, who embraces his daughter during her death throes.)
8. The herbicide 2,4-D causes a temporary interruption of nitrification. (p. 57)
(The natural oxidation of ammonia into nitrite supplies the soil with natural nutrition necessary for plants to flourish. Without plant life, humankind could not survive.)
9. Justice William O. Douglas, in his recent book *My Wilderness: East to Katahdin*, has told of an appalling example of ecological destruction wrought by the United States Forest Service in the Bridger National Forest in Wyoming. (p. 67)
(Rachel Carson gained limited support for her theories until William O. Douglas, a naturalist and U.S. Supreme Court justice, endorsed Silent Spring. In his opinion, the book was "the most important chronicle of this century for the human race.")
10. A retired banker from Winnipeg, Charles Broley, achieved ornithological fame by banding more than 1,000 young bald eagles during the years 1939-49. (p. 118)
(Charles Lavelle Broley (1879-1959) retired from finance and moved from Canada to Florida. During eight years of banding 820 eagles, he traced migratory patterns. His discovery that

eagles were declining in number alarmed scientists, who blamed egg collectors and DDT for the decimation of the species.)

Alternate Assessment

1. List examples of hazards to workers, for example, touching poisonous residue on leaves, breathing toxic gas in silos, handling pesticide containers, spilling biocides on the skin, and eating toxic foods or drinking poisoned water.
2. Compile a list of actions and statements that demonstrate greed, lies, and half-truths from the pesticide industry.
3. Compose a scene in which Rachel Carson delivers a speech to workers at Monsanto.
4. Account for the author's dramatization of life webs in forests, streams, estuaries, croplands, lakes, and yards.
5. Describe methods of suppressing pests without endangering the environment, for example, introducing a beetle to kill prickly pear in Australia or spreading milky spore over lawns to kill the grub worms before they can develop into Japanese beetles.

Vocabulary Test

Complete each of the following sentences with an appropriate pair of words from the list below. You will have answers left over when you finish.

acreages/provisions
blunderingly/parasitism
contingency/ephemeral
detoxification/enzymes
indiscriminately/synthesis
lichen/inert
mutagenic/malignancy
pupae/arsenicism
scrupulously/residues
tolerance/processor

antivivisectionist/bracken
cochineal/dispersion
desensitized/allergen
faltered/oases
innocuous/dissemination
macerate/havoc
prohibition/omen
remote/sustained
selenium/plasticizing
zone/subsurface

1. In effect, then, to establish _____ is to authorize contamination of public food supplies with poisonous chemicals in order that the farmer and the _____ may enjoy the benefit of cheaper production.
2. Besides the once _____ garden hose, power mowers also have been fitted with devices for the _____ of pesticides, attachments that will dispense a cloud of vapor as the homeowner goes about the task of mowing his lawn.
3. A bizarre happening in the United States during the _____ era about 1930 was an _____ of things to come.
4. An allergist keeps his patients _____ by repeated small injections of the _____.
5. Minute causes produce mighty effects; the effect, moreover, is often seemingly unrelated to the cause, appearing in a part of the body _____ from the area where the original injury was _____.
6. If the farmer _____ follows the instructions on the labels, his use of agricultural chemicals will produce no _____ larger than are permitted by the Food and Drug Administration.
7. Here and there authority had somehow _____ and by an unaccountable oversight there were _____ of beauty in the midst of austere and regiment control.
8. Rain, falling on the land, settled down through pores and cracks in soil and rock, penetrating deeper and deeper until eventually it reaches a _____ where all the pores of the rock are filled with water, a dark, _____ sea, rising under hills, sinking beneath valleys,
9. It is believed generally that reduction of crop _____ under _____ of the Soil Bank will stimulate interest in use of chemicals to obtain maximum production on the land retained in crops.
10. The _____ is accomplished by one of the _____ of the liver.

Comprehension Test A

Part I: True/False (30 points)

In the space at left, write T if the statement is complete true or F if any of the statement is false.

- _____ 1. Porous rock filters carcinogens from groundwater.
- _____ 2. Surplus planes from World War II fostered the aerial spraying industry.
- _____ 3. Poisoned earthworms produce sterility in robins.
- _____ 4. Dusting for spruce budworms created a health hazard in greater Detroit, Michigan.
- _____ 5. It is almost impossible to avoid chlorinated hydrocarbons in food.
- _____ 6. Western stockmen insisted on eradicating sage to increase grasslands.
- _____ 7. The loss of aquatic insects reduced the size of freshwater trout.
- _____ 8. Chemical spraying produces insect strains that are resistant to poisons.
- _____ 9. German technology created poisons to clear ditches and roadsides of brush.
- _____ 10. Justice William O. Douglas dismissed a review of the Long Island injunction by the U.S. Supreme Court.
- _____ 11. The earth produces soil deep in the crevices of rocks that line the water table.
- _____ 12. Marigolds suppress nematodes.
- _____ 13. Factories in Great Britain halted production of arsenic poisons.
- _____ 14. The body stores toxins in fat.
- _____ 15. Cholinesterase is a natural enzyme that suppresses cell metabolism and carcinogens.

Part II: Multiple Choice (20 points)

Select a response to complete the following statements. Place your choice in the space at left.

- _____ 1. Rachel Carson identifies the deadlier poisons as
 - A. arsenic.
 - B. organic.
 - C. alkyls.
 - D. chemical weapons.
- _____ 2. The vegetable most likely to absorb toxins is the
 - A. sweet potato.
 - B. carrot.
 - C. potato.
 - D. lettuce leaf.
- _____ 3. Deadly gas afflicted farm workers in
 - A. silos.
 - B. cabbage fields.
 - C. orchards.
 - D. mowers.
- _____ 4. Estuaries carry
 - A. polluted groundwater to the sea.
 - B. aerial spray to Alabama cotton fields.
 - C. the bodies of sterile and dying songbirds.
 - D. soil-aerating earthworms to croplands.
- _____ 5. Sprayers in Maine and New Brunswick
 - A. identified the grubs that develop into Japanese beetles.
 - B. preferred brown roadsides to bracken.
 - C. destroyed freshwater oyster beds.
 - D. fought budworms.
- _____ 6. English chimney sweeps contracted scrotal cancer from
 - A. silicosis.
 - B. selenium.
 - C. infected birds in chimneys.

D. soot.

_____ 7. Rachel Carson denounces the creation of

- A. aerial spray zones over cities.
- B. tolerances for poison in food.
- C. chemicals for war.
- D. the Food and Drug Administration.

_____ 8. Humans cannot survive without

- A. nitrogen-fixing in the liver.
- B. underground streams.
- C. plants.
- D. estuaries.

_____ 9. Cholinesterase

- A. threatens young salmon.
- B. disrupts the Pacific Flyway.
- C. rids the body of toxins.
- D. simplifies the job of spot spraying.

_____ 10. Toxic chemicals can form in

- A. the fatty tissue in earthworms.
- B. groundwater.
- C. radioactive fallout from planes.
- D. healthy plants.

Part III: Completion (20 points)

Fill in the blanks below with a word or phrase that completes the sentence. Place your answer in the space provided at left.

1. A cheaper and less harmful method of killing beetles involves spreading a milky _____ that destroys _____ before they become beetles.
2. During civic attempts to halt Dutch _____ disease, studies linked the poisoning of _____ with the sterility of birds and the deaths of nestlings.
3. In New Brunswick, the poisoning of spruce budworm affected _____ and trout by the killing of aquatic _____ on which they feed.
4. During the war on the _____ moth on Long Island, citizens sought _____ against haphazard spraying.
5. Signs of increased toxicity include hepatitis and _____ of the liver and disorders of the _____ system.

Part IV: Essay Questions (30 points)

1. Describe how workers endanger themselves from chemical poisons.
2. Explain why Rachel Carson feared for the future of the planet.
3. Discuss the effect of resurgent insect species on chemical revenues.
4. Account for the dangers homeowners face from yard and garden poisons.
5. Summarize events that corroborate Rachel Carson's prophecies.

Comprehension Test B

Part I: Identify (30 points)

Identify the names and terms described below. Place your response in the blank provided at left.

- _____ 1. produces cholinesterase
- _____ 2. wrote pamphlets for fisheries
- _____ 3. are the world's most poisonous substances
- _____ 4. sought injunctions against aerial spraying
- _____ 5. banded eagles
- _____ 6. arrived in burl logs
- _____ 7. first appeared in New Jersey
- _____ 8. caused cancer in chimney sweeps
- _____ 9. are the gender most susceptible to toxins
- _____ 10. causes part male and part female mosquitoes
- _____ 11. believed that humanity has an obligation to endure
- _____ 12. was synthesized in Germany in 1874
- _____ 13. covers the planet with life-supporting humus and minerals
- _____ 14. requires the work of honeybees
- _____ 15. kills grub worms with one application

Part II: Multiple Choice (20 points)

Underline a word or phrase that completes each of the following sentences.

1. In (**Lower Klamath, Texas, New Brunswick, Alabama**), the poisoning of spruce budworm affected salmon and trout by killing off aquatic insects on which they feed.
2. Rodent poisons in (**warehouses, estuaries, underground streams, milk**) soak through burlap bags and packages.
3. The work of body cells in storing and using energy comes to a halt from (**nitrogen-fixing, sterility, survival of the fittest, radiation**) and chemical poisoning.
4. Those habitats that experience the (**evolution, eradication, aerial spray, genetic mutation**) of one species overproduce the life forms on which the missing being once fed.
5. Some alternatives to chemical poisons involve mass sterilization of pests or violation of the insect's (**ultra-violet rays, life processes, migratory flyway, reproductive enzymes**).
6. The emergence of resistant strains increased the (**malaria, typhus, encephalitis, dysentery**)-bearing Anopheles mosquito.
7. A side effect of tampering with nature is (**liver, hydrocarbon, toxic, gene**) mutation, a shift in nature that could boomerang and destroy humankind.
8. Instead of (**selenium, arsenic, milky spore, malathion**), which has been banned, modern insecticides rely on chlorinated hydrocarbons.
9. When ingested by small organisms, poisons become concentrated and pass to (**humus, fungi, predators, decayed matter**).
10. The convenience of poisons bypassed selective spraying and natural suppression of pests, such as the introduction of the Argentine moth to reduce (**cacti, screwworms, salmon fry, Dutch elm disease**) in Australia.

Part III: Short Answer (20 points)

Supply a word or phrase in answer to the following questions. Place your response in the blank provided.

- _____ 1. What gas forms naturally in swamps?
- _____ 2. Whose theory explains the buildup of carcinogens in the body?
- _____ 3. How often must a homeowner apply milky spore treatment?
- _____ 4. What did Charles Broley band?
- _____ 5. Who wrote *The Formation of Vegetable Mould*?
- _____ 6. From what country did the gypsy moth arrive?
- _____ 7. What controlled St. Johnswort in the United States?
- _____ 8. Whom did the American Society of Ichthyologists and Herpetologists ask to stop spraying poison?
- _____ 9. Where did state and federal authorities dust with aldrin to control Japanese beetles?
- _____ 10. What poisoned aquatic plant killed birds at Tule Lake?

Part IV: Essay Questions (30 points)

- 1. Explain why aerial spray is not controllable.
- 2. Contrast the hazards of chlordane and arsenic.
- 3. Describe the kinds of data proving that biocides cause human disease.
- 4. Summarize the ways in which nature relies on diversity.
- 5. Establish the importance of Rachel Carson's book to the ecology movement.

Answer Key

VOCABULARY TEST

- | | |
|----------------------------|----------------------------|
| 1. tolerance/processor | 6. scrupulously/residues |
| 2. innocuous/dissemination | 7. faltered/oases |
| 3. prohibition/omen | 8. zone/subsurface |
| 4. desensitized/allergen | 9. acreages/provisions |
| 5. remote/sustained | 10. detoxification/enzymes |

Comprehension Test A

Part I: True/False (30 points)

- | | | |
|------|-------|-------|
| 1. F | 6. T | 11. F |
| 2. T | 7. F | 12. T |
| 3. T | 8. T | 13. T |
| 4. F | 9. F | 14. T |
| 5. T | 10. F | 15. F |

Part II: Multiple Choice (20 points)

- | | |
|------|-------|
| 1. C | 6. D |
| 2. B | 7. B |
| 3. A | 8. C |
| 4. A | 9. C |
| 5. D | 10. B |

Part III: Completion (20 points)

1. spore, grub worms
2. elm, earthworms
3. salmon, insects
4. gypsy, injunctions
5. cirrhosis, nervous

Part IV: Essay Questions (30 points)

Answers will vary.

COMPREHENSION TEST B

Part I: Identification (30 points)

- | | | |
|-------------------|----------------------|------------------|
| 1. liver | 6. Dutch elm disease | 11. Jean Rostand |
| 2. Rachel Carson | 7. Japanese beetles | 12. DDT |
| 3. alkyls | 8. soot | 13. soil |
| 4. Long Islanders | 9. women | 14. pollination |
| 5. Charles Broley | 10. DDT | 15. milky spore |

Part II: Multiple Choice (20 points)

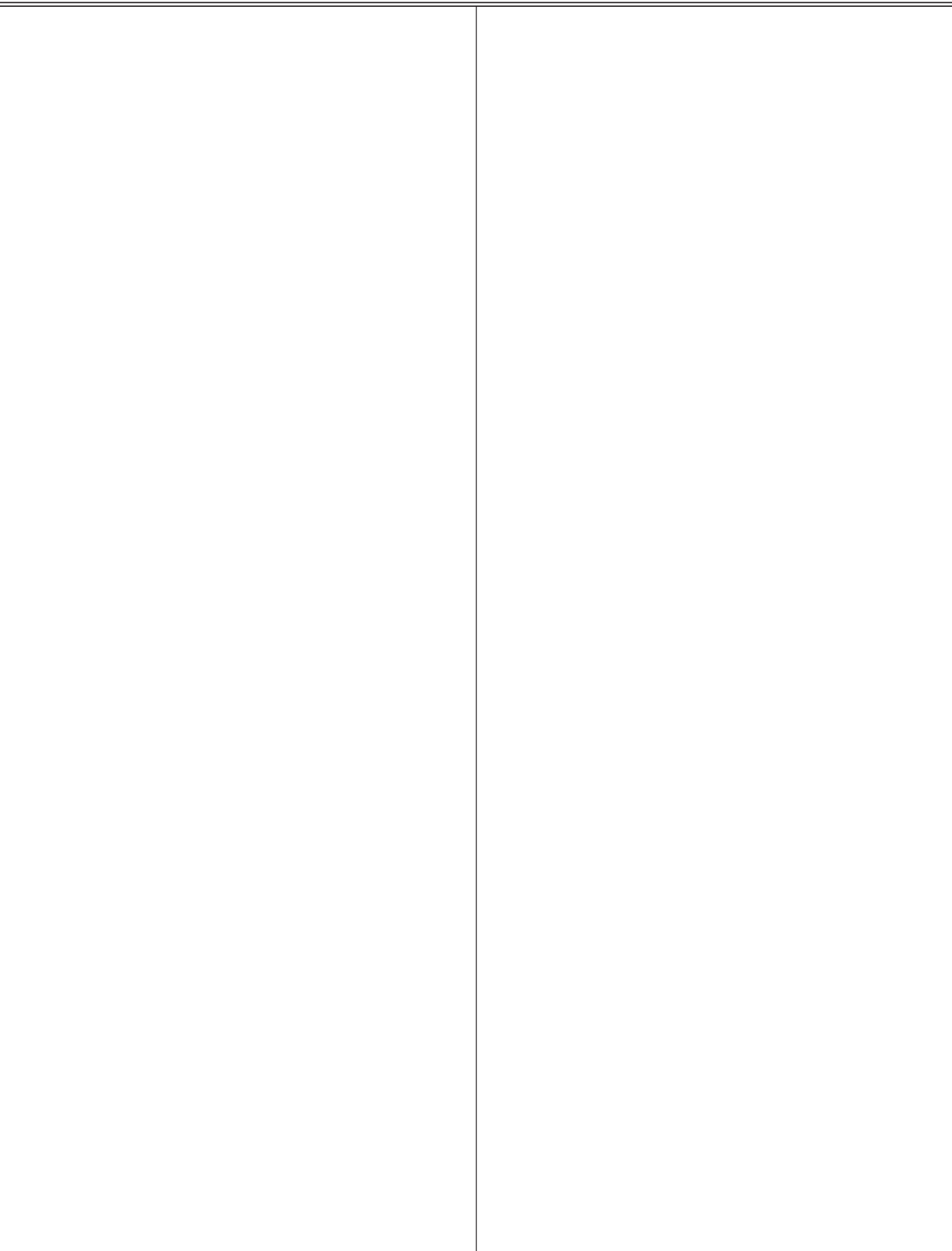
- | | |
|-------------------|--------------|
| 1. New Brunswick | 6. malaria |
| 2. warehouses | 7. gene |
| 3. radiation | 8. arsenic |
| 4. eradication | 9. predators |
| 5. life processes | 10. cacti |

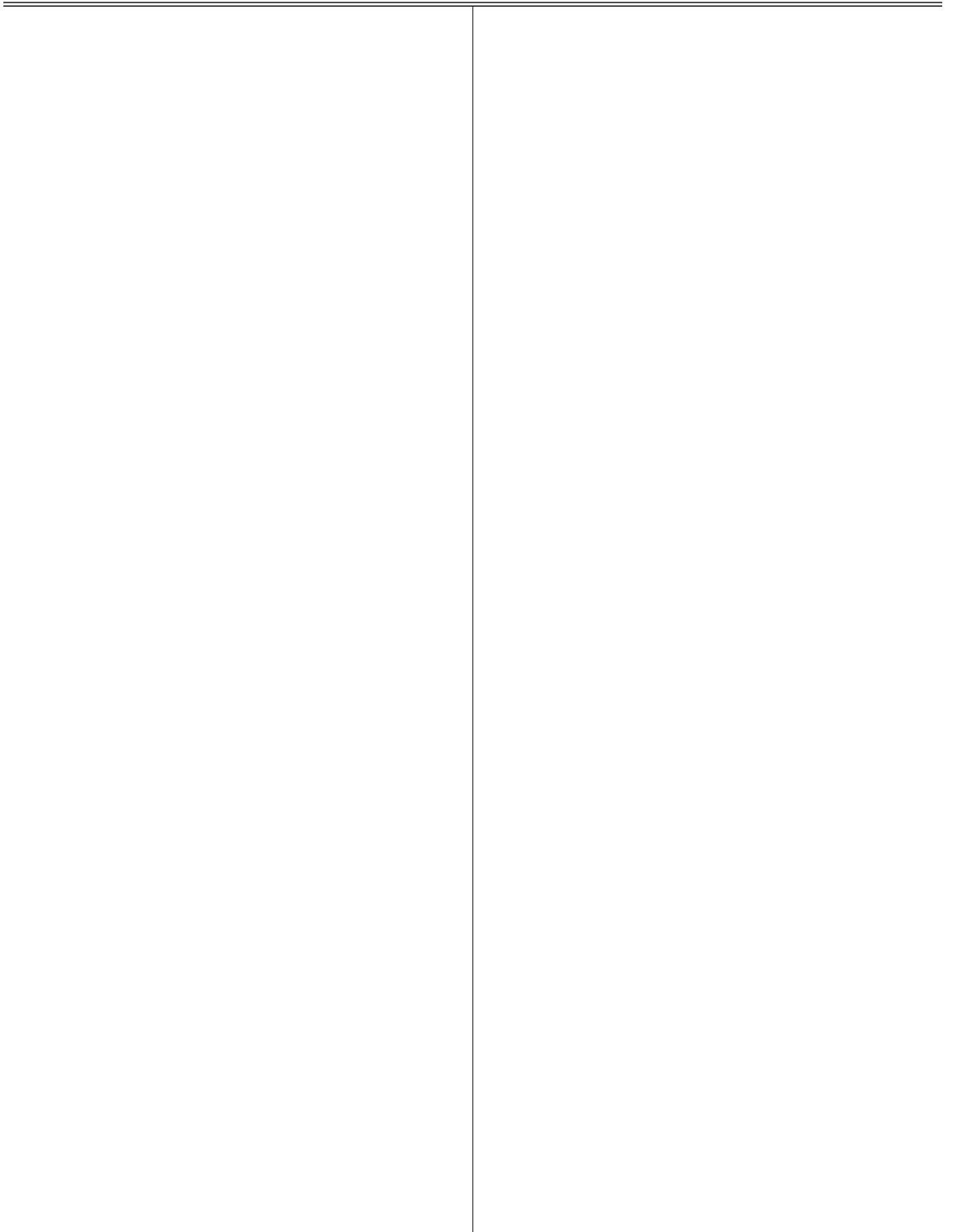
Part III: Short Answer (20 points)

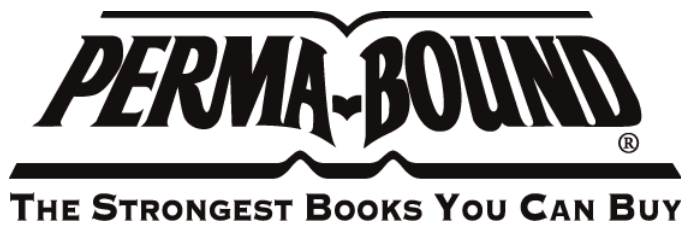
- | | |
|--------------------|------------------------------|
| 1. methane | 6. Holland |
| 2. Warburg | 7. beetles |
| 3. once | 8. Department of Agriculture |
| 4. American eagles | 9. Detroit |
| 5. Charles Darwin | 10. plankton |

Part IV: Essay Questions (30 points)

Answers will vary.







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