ART

An Introduction to Environmental and Environmentalist Art

I. ART FUNDAMENTALS 20%
- A. Introduction to Art History
  - 1. Methods and Inquiries of Art History
    - a. The Nature of Art Historical Inquiry
    - b. Sources, Documents, and the Work of Art Historians
    - c. The Development of Art History
  - 2. Brief Overview of Art in the Western World
    - a. Ancient Civilizations
    - b. Greek and Roman Art
    - c. Early Christian and Medieval Art
    - d. The Renaissance and Baroque
    - e. Rococo, Neoclassicism, and Romanticism
    - f. Realism and Impressionism
    - g. Post-Impressionism and Other Late Nineteenth-Century Developments
    - h. The Emergence of Modernism
    - i. Abstraction
    - j. Pop Art, Minimalism, and Photo Realism
    - k. Earthworks, Installations, and Performance
  - 3. Brief Overview of Non-Western Art
    - a. Asian Art
    - b. African and Oceanic Art
    - c. Islamic Art
    - d. The Americas
- B. Elements of Art
  - 1. Formal Qualities of Art
    - a. Line
    - b. Shape and Form
    - c. Perspective
    - d. Color
    - e. Texture
    - f. Composition
  - 2. Processes and Techniques
    - a. Drawing
    - b. Printmaking
    - c. Painting
    - d. Photography
    - e. Sculpture
    - f. Mixed Media
    - g. Performance
    - h. Craft and Folk Art
    - i. Architecture

II. LAND USE AND LAND RIGHTS 20%

A. Introduction to Artistic Perspectives on Land Ownership and Land Use
B. Selected Work: Allora & Calzadilla, *Land Mark (Foot Prints)*, 2002
C. Selected Work: Kent Monkman, *The Fourth World*, 2012
D. Selected Work: Bonnie Devine, *Battle for the Woodlands*, 2014–15 E. Selected Work: Will Wilson, *Church Rock Spill Evaporation Ponds*, Church Rock, New Mexico, Dinétah, 2019

III. POLLUTION AND EXTRACTION 20%

A. Introduction to Issues of Waste, Pollution, and Industrial Extraction
B. Selected Work: Agnes Denes, *Wheatfield—A Confrontation: Battery Park Landfill, Downtown Manhattan—With Agnes Denes Standing in the Field*, 1982
C. Selected Work: Noah Purifoy, *Offshore Drilling*, 1995
D. Selected Work: Subhankar Banerjee, *Caribou Migration I*, 2002 E. Selected Work: Vik Muniz, *Marat (Sebastião)* from *Pictures of Garbage,* 2008

IV. ECOLOGICAL SYSTEMS OF KNOWLEDGE 20%

A. Introduction to Systems Thinking and the Ecosystem in Art
B. Selected Work: Helen and Newton Harrison, *Shrimp Farm, Survival Piece #2*, 1971
C. Selected Work: Hans Haacke, *Rhine Water Purification Plant*, 1972
D. Selected Work: Nancy Holt, *Sun Tunnels*, 1973–76
E. Selected Work: Mark Dion, *A Meter of Jungle*, 1992
F. Selected Work: Pierre Huyghe, *Untilled*, 2011–12

V. THE HUMAN EXPERIENCE OF ENVIRONMENT 20%

A. Introduction to the Subjectivity of Experiencing Environments
B. Selected Work: Alma Thomas, *Snoopy–Early Sun Display on Earth*, 1970
C. Selected Work: Ana Mendieta, *Untitled: Silueta Series*, 1978
D. Selected Work: Rebecca Belmore, *Ayum-ee-aawach Oomama-mowan: Speaking to Their Mother*, 1991
E. Selected Work: Mel Chin, *Unmoored*, 2018
F. Selected Work: LaToya Ruby Frazier, *Shea Cobb with Her Mother Ms. Reneé and Her Daughter Zion at Nephratiti's Wedding Reception, Standing Outside the Social Network Banquet Hall, Flint, Michigan*, from the series *Flint is Family: Act I*, 2016–17

ECONOMICS

An Introduction to Economics and the Economics of Climate Change

I. FUNDAMENTAL ECONOMIC CONCEPTS 10%
- A. Basic Assumptions of Economics
  1. Scarcity
  2. Trade-offs
  3. Opportunity Cost
  4. Rationality
  5. Gains from Trade
- B. Models and Economic Theory
- C. Positive and Normative Economics
- D. Efficiency as a Goal
- E. Microeconomics and Macroeconomics

II. MICROECONOMICS 40%
- A. Perfectly Competitive Markets
  1. Markets
  2. Demand
  3. Shifts in the Demand Curve
     a. Income
     b. The Prices of Related Goods
     c. Tastes
     d. Expectations
     e. Number of Buyers
  4. Supply
  5. Shifts in the Supply Curve
     a. Input Prices
     b. Technology
     c. Expectations
     d. Number of Sellers
  6. Equilibrium
  7. The Characteristics of Competitive Market Equilibrium
- B. Applications of the Competitive Market Model
  1. Changes in Market Equilibrium
  2. Elasticity
  3. Using Elasticity
- C. Evaluating Government Policy: The Impact of Price Controls and Taxes
  1. Price Controls
  2. Taxes
- D. International Trade
  1. An Isolated Economy
  2. Adding the Opportunity to Trade
  3. Comparative Advantage and the Gains from Trade
  4. The Political Economy of Trade
- E. The Profit Motive and the Behavior of Firms
  1. Economic Profits and Accounting Profits

2. Finding the Firm's Supply Curve
3. Entry, Exit, and the Market Supply Curve

F. Imperfect Competition
1. Monopoly
2. Monopoly Supply
3. Welfare Consequences of Monopoly
4. Dealing with Monopolies
5. Price Discrimination
6. Oligopoly
7. Monopolistic Competition

G. Creative Destruction: The Profit Motive and the Sources of Economic Change

H. Market Failures
1. Externalities
2. The Effect of Externalities on Resource Allocation
3. Private Responses to Externalities
4. Government Regulation of Externalities
5. Property Rights
6. The Effects of Private Ownership
7. Public and Private Goods
a. Private Goods
b. Common Resources
c. Collective Goods
d. Public Goods

I. Institutions, Organizations, and Government
1. Pork Barrel Politics
2. Rent-Seeking
3. What Is the Proper Role for Government?

III. MACROECONOMICS 30%

A. Macroeconomic Issues
1. Economic Growth and Living Standards
2. Recessions and Expansions
3. Unemployment
4. Inflation
5. International Trade

B. Macroeconomic Measurement
1. Measuring Total Output: Gross Domestic Product
a. Market Value
b. Final Goods and Services
c. Within a Country
d. During a Specified Period
2. Understanding What GDP Measures
3. Other Ways to Measure GDP: Expenditures Equal Production
4. Yet Another Way to Measure GDP: Income Equals Production Equals Expenditures
5. Real GDP
6. Measuring Inflation
7. Unemployment
a. Frictional Unemployment

b. Structural Unemployment
c. Cyclical Unemployment

C. Economic Growth, Productivity, and Living Standards
1. The Circular Flow Model of the Economy
2. What Determines How Much an Economy Produces?

D. Savings, Investment, and the Financial System
1. Financial Markets
a. The Bond Market
b. The Stock Market
2. Financial Intermediaries
a. Banks
b. Mutual Funds
3. Saving and Investment in Aggregate
4. International Capital Flows in an Open Economy
5. How Financial Markets Coordinate Saving and Investment Decisions

E. Money and Prices in the Long Run
1. What Is Money?
2. Measuring Money
3. The Federal Reserve System, Banks, and the Supply of Money
4. Bank Runs
5. Money and Inflation in the Long Run
6. Why Worry about Inflation?

F. Short-Run Economic Fluctuations
1. Characteristics of Short-Run Fluctuations
2. Potential Output, the Output Gap, and the Natural Rate of Unemployment
3. Explaining Short-Run Fluctuations in Output
4. The Aggregate Demand Curve
a. Wealth Effects
b. Interest Rate Effects
c. Foreign Exchange Effects
5. The Aggregate Supply Curve
6. The Keynesian Model of Short-Run Fluctuations
7. Inflation in the Keynesian Model
8. Using Fiscal and Monetary Policy to Stabilize the Economy

IV. CLIMATE CHANGE: ECONOMICS MEETS ECOLOGY 20%

A. Introduction and Overview
1. The Current Crisis—Recent Developments
2. Economics and Ecology: A Need for Synthesis
3. Overview of Topics
a. Concepts and Climate
b. Economic Issues and Climate
c. Policy Responses and Climate Change
d. Summing Up: Viable Courses of Action

B. Economic Concepts and Climate: Theory and Practice
1. Externalities: Doing Unto Others
a. Positive and Negative Externalities

b. One-way and Reciprocal Externalities
c. Control and Time
d. Resolution: Economic and Legal Means

2. Public Goods and Public Spaces
a. Definitions: Rivalry and Excludability
b. Public Goods and Public Bads: Social Benefits and Costs
c. Economic House: Obligations and Free Riding
d. Space and Jurisdiction
e. Norms, Institutions, and Expectations

3. Common Property and Collective Action
a. The Tragedy of the Commons
b. Collective Action and Its Critics
c. Space and Jurisdiction: From Village Commons to Global Village
d. Managing the Commons: Who Shall Guard the Guardians?

4. Discounting: The Shadow of the Future
a. How Much Is Something Today Worth Tomorrow?
b. Looking Forward and Looking Backward
c. Whose Child Is This? Obligations to Future Generations
d. Spending Now or Saving for Later?
e. Time and Sustainability

C. Economics Issues and Climate

1. Damages Due to Climate Change
a. Economic Damages Due to Increasing Temperatures
b. The Social Cost of Carbon
c. The Uncertainty of Damage Estimates

2. Burdens Facing Poorer Regions
a. The Unequal Impacts of Climate Change
b. Latitude, Location, and Household Income
c. Cities, States, and Nations
d. Bargaining across Jurisdictions and the Global Commons

3. Rapid Reductions in Renewables' Costs
a. The End of the Hydrocarbon Epoch: How Soon?
b. The Renewables Surprise
c. The Cost Race
d. Playing Favorites and Betting which Road Is Right

D. Policy Responses to Climate Change

1. Do Nothing and Hope for the Best
a. The Case for Waiting and Seeing
b. The Risks of Delay: The Logic of "No Regrets"

2. Unilateral Intervention: Geo-engineering
a. Free-driving: I'm in Charge Here
b. Volcanic Disruption
c. Each against All

3. Negotiating over Climate Targets
a. The False Promise of Overcommitment
b. The Problem of Enforcement
c. The Fuzzy Locus of Decision and Responsibility

d. The Absence of Alternatives
4. Multilateralism: A Global Environment Organization (GEO)
a. Economic Interdependence and Ecological Interdependence
b. The Commercial Commons and the Climate Commons: Friends or Foes?
c. Voluntary Commitment with Strings Attached
d. Managing the Climate Commons
E. Summing Up
1. Tragic Choices: What Is “Least Worse”?
2. Collective Responsibility and the Obligations of Those Better Off
3. Russian Dolls: A Nested Negotiating Strategy

LITERATURE
An Introduction to Environmental Literature

I. CRITICAL READING 15%
- A. Purpose and Main Idea
- B. Structure
- C. Restatement of Information
- D. Genres and their Characteristics
- E. Language and Tone
- F. Grammar and Syntax
- G. Vocabulary in Context
- H. Diction

II. HISTORICAL OVERVIEW OF ENVIRONMENTAL LITERATURE 10%

- A. What is Environmental Literature?
  - 1. Utopias
  - 2. Dystopias
- B. England: The Romantics
  - 1. *Key Players*: Blake, Wordsworth, and Coleridge
  - 2. *Key Players*: Second Wave—Keats, Byron, and Shelley
- C. The Transcendentalist Movement in the U.S.
  - 1. As a Philosophy
  - 2. *Key Players*: Emerson and Thoreau
- D. Philosophies of Environmental Action
  - 1. *Key Players*: John Muir and Aldo Leopold
  - 2. Literatures of Preservation and Conservation
- E. Environmental Awakening
  - 1. *Key Players*: Rachel Carson and *Silent Spring*
  - 2. *Key Players*: Ursula K. Le Guin and Environmental Ethics
- F. The City and the Country
  - 1. *Key Players*: Nnedi Okorafor, Postcolonial Cityscapes
  - 2. *Key Players*: Barbara Kingsolver, Rural America
- G. Eco-Justice and Environmental Literature
  - *Key Players*: Octavia E. Butler and Vandana Shiva
- H. The Rise of Climate Fiction
  - 1. *Key Players*: Stephanie LeMenager and Amitav Ghosh
  - 2. Climate Change and Hope in Contemporary Climate Narratives
- I. Environmental Appeals for Social Change in Nonfiction

III. LINDA HOGAN, *SOLAR STORMS* (1994) 45%
- A. Biographical Context: Linda Hogan
- B. Historical Context: The James Bay Project
- C. Plot and Structure: Indigenous Ecological Time in the Novel
- D. *Solar Storms*: Major Themes
  - 1. Overview of *Solar Storms*
  - 2. Ecofeminism: Women in Environmental Literature

3. The Environment and Colonization
4. Animals and the Environment
5. Environmental Place
6. Indigenous Literature and Climate Change
7. Tension Between Technology and Nature
8. Environmental Justice
9. The Importance of Community

E. Cast of Characters in *Solar Storms*

F. Analysis of *Solar Storms* and Its Themes

1. Healing the Land, Healing the Self
2. Land, Profit, and Power
3. Hannah's Scars
4. Remembering the Wilderness
5. Finding Hope in the Face of Ecological Catastrophe

G. Literary Contexts of the Novel

1. Ecocriticism and Ecofeminism: Women in Environmental Literature
2. Colonialism and the Environment
3. Animals and the Environment
4. Environmental Place
5. Indigenous Literature and Climate Change

IV. SHORTER SELECTIONS 30%

A. SELECTED WORK: "THE WORLD IS TOO MUCH WITH US" (1807)

1. William Wordsworth: Biography
2. Analysis: Elegy and Industrialism

B. SELECTED WORK: "FREEWAY 280" (1981)

1. Lorna Dee Cervantes: Biography
2. Analysis: Landscape and Wilderness

C. SELECTED WORK: "DIFFERENT WAYS TO PRAY" (1980)

1. Naomi Shihab Nye: Biography
2. Analysis: Sacred Nature; New Pastoral

D. SELECTED WORK: "WEBCAM THE WORLD" (2009)

1. Heather McHugh: Biography
2. Analysis: Documenting Nature in the Age of Climate

Change E. SELECTED WORK: "THE BLUE" (2011)

1. Camille T. Dungy: Biography
2. Analysis: Nature and Impermanence

F. SELECTED WORK: "THE AIR SMELLED DIRTY" (2017)

1. Marge Piercy: Biography
2. Analysis: Nature, Place, and Memory

G. SELECTED WORK: "OUR PURPOSE IN POETRY: OR, EARTHRISE" (2018)

1. Amanda Gorman: Biography
2. Analysis: Climate Change

H. SELECTED WORK: "THE MACHINE STOPS" (1909)

1. E. M. Forster: Biography
2. Analysis: Technology and Isolation

I. SELECTED WORK: "ONCE MORE TO THE LAKE" (1941)
    1. E. B. White: Biography
    2. Analysis: Nature and Nostalgia
J. SELECTED WORK: "The Toxic Donut" (1993)
    1. Terry Bisson: Biography
    2. Analysis: Toxic Waste, Science, and Environmentalism
K. SELECTED WORK: "EPIPHANY IN THE BEANS" excerpt from *Braiding Sweetgrass* (2013)
    1. Robin Wall Kimmerer: Biography
    2. Analysis: Restoring the Relationship between Land and People
L. SELECTED WORK: "SPACE LEEK" (2019)
    1. Chen Quifan: Biography
    2. Analysis: Science, Food, and Climate

MATHEMATICS

Overview of Permutations and Combinations, Algebra, and Statistics

I. OVERVIEW OF PERMUTATIONS AND COMBINATIONS 10%

A. Multiplication Principle

B. Permutations

C. Combinations

II. ALGEBRA 40%

A. Sequences and Series
1. Arithmetic and Geometric Sequences
2. Arithmetic and Geometric Series
3. Sigma Notation

B. Polynomials
1. Adding and Subtracting
2. Multiplying

C. Binomial Expansion Theorem

D. Compound Interest
1. Investing and Borrowing
2. Annuities and Loans

E. Euler's Constant

III. STATISTICS 50%

A. Descriptive Statistics
1. Mean, Median, and Mode
2. Range, Quartiles, and IQR

B. Measures of Variation
1. Variance
2. Standard Deviation
3. Z-score

C. Basic Probability
1. Independent

2. Dependent

D. Probability Distributions
1. Expected Value
2. Variance and Standard Deviation

E. The Binomial Distribution

F. The Normal Distribution

MUSIC
Music and the Natural World

I. BASIC ELEMENTS OF MUSIC THEORY 20%
- A. Sound and Music
  - 1. Definitions
    - a. Music Is Sound Organized in Time
    - b. Music of the Western World
  - 2. Physics of Musical Sound
    - a. Sound Waves
    - b. Instruments as Sound Sources
- B. Pitch, Rhythm, and Harmony
  - 1. Pitch
    - a. Pitch, Frequency, and Octaves
    - b. Pitch on a Keyboard
    - c. Pitch on a Staff
    - d. Pitch on the Grand Staff
    - e. Overtones and Partials
    - f. Equal Temperament: Generating the Twelve Pitches by Dividing the Octave
    - g. Scales: Leading Tone, Tonic, Dominant
    - h. Intervals
    - i. Intervals of the Major Scale
    - j. Minor Scales and Blues Inflections
    - k. Melody Defined; Example, Using Scale Degrees
    - l. Contour
    - m. Range and Tessitura
  - 2. Rhythm
    - a. Beat
    - b. Tempo
    - c. Meter: Duple, Triple, and Quadruple
    - d. Rhythmic Notation
    - e. Time Signature
    - f. Simple and Compound Subdivision
    - g. Mixed and Irregular Meter
    - h. Syncopation
    - i. Polyrhythm
  - 3. Harmony
    - a. Common-Practice Tonality
    - b. Chords
      - i. Triads
      - ii. Inversions
    - c. Keys
      - i. Keys and Key Signatures
      - ii. Hierarchy of Keys: Circle of Fifths
    - d. Harmonic Progression
      - i. Dissonance and Consonance
      - ii. Diatonic Triads

iii. The Dominant Triad's Special Role
iv. Bass Lines
v. The Dominant Seventh Chord
vi. Example: A Harmonized Melody
e. Other Diatonic Chords
f. Chromatic Harmonies and Modulation
g. Beyond Common Practice

C. Other Aspects of Musical Sound
1. Texture, Counterpoint, Instrumentation, More Timbre
2. Dynamics, Articulation, Ornamentation

D. Form in Music
1. Perceiving Musical Form
2. Elements of Form
a. Motive
b. Phrase
c. Cadence
d. Theme
e. Introduction and Coda
3. Common Forms
a. Repetition
b. Variation
i. Theme and Variations
ii. 12-Bar Blues
iii. Improvisation
c. Contrast
i. Ternary and Rondo Forms
ii. 32-Bar Form
iii. Verse-Chorus Form
d. Development
i. Fugue
ii. Sonata Form

E. Which Is the Real Music? Scores, Recordings, and Performance

II. THE NATURAL WORLD 28%

A. Marvels Made Musical
1. Grofé and the Grand Canyon
2. LISTENING COMPANION 1: *GRAND CANYON SUITE,* "ON THE TRAIL" (1929–31) – FERDE GROFÉ

B. Stormy Weather
1. Beethoven Lets It Thunder
2. LISTENING COMPANION 2: SYMPHONY NO. 6, OP. 68 "PASTORAL," MVT. 4, "GEWITTER STURM: ALLEGRO" ("THUNDERSTORM: ALLEGRO") (1808) – LUDWIG VAN BEETHOVEN

C. The Globe's Growing Things
1. Takemitsu and a Tree
2. LISTENING COMPANION 3: *AME NO KI (RAIN TREE)* (EXCERPT) (1981) – TŌRU TAKEMITSU

D. Playing with Pollinators
1. The Antics of an Insect
2. LISTENING COMPANION 4: *THE TALE OF TSAR SALTAN,* "FLIGHT OF THE BUMBLEBEE" (1900) – NIKOLAI RIMSKY-KORSAKOV

E. Birds as Composers
1. Hearing a Hermit Thrush
2. LISTENING COMPANION 5: *HERMIT THRUSH AT MORN*, OP. 92, NO. 2 (1921) – AMY BEACH

III. CELEBRATING THE PLANET 17%
A. Singing the Seasons
1. Medieval Merriment
2. LISTENING COMPANION 6: *SUMER IS ICUMEN IN* (C.1250) – ANONYMOUS
B. Trees of Green, Red Roses Too
1. Counting the Blessings
2. LISTENING COMPANION 7: "WHAT A WONDERFUL WORLD" (1967) – BOB THIELE ["GEORGE DOUGLAS"] AND GEORGE DAVID WEISS
C. Warming Up After the Cold War
1. Hope for Humanity
2. LISTENING COMPANION 8: *GLOBAL WARMING* (1990) – MICHAEL ABELS

IV. WORDS OF WARNING 35% A. You Don't Know What You've Got 'Til It's Gone
1. Paving Paradise
2. LISTENING COMPANION 9: "BIG YELLOW TAXI" (1970) –JONI MITCHELL
B. Poison Is the Wind That Blows
1. Gaye Goes Green
2. LISTENING COMPANION 10: "MERCY MERCY ME (THE ECOLOGY)" (1971) – MARVIN GAYE
C. Postmodern Anxiety
1. Ice Age Coming . . .
2. LISTENING COMPANION 11: "IDIOTEQUE" (2000) – THOMAS YORKE, PHILIP SELWAY, EDWARD O'BRIEN, COLIN GREENWOOD, JONATHAN GREENWOOD (RADIOHEAD), AND PAUL LANSKY
D. Calling For Action
1. Dangers Up Ahead
2. LISTENING COMPANION 12: "DESPITE REPEATED WARNINGS" (2018) – PAUL MCCARTNEY
E. Why Don't We Listen?
1. Celebrity Obsession
2. LISTENING COMPANION 13: "FEELS LIKE SUMMER" (2018) – DONALD GLOVER ["CHILDISH GAMBINO"]
F. Is It Too Late?
1. Eight Million Voices
2. LISTENING COMPANION 14: *ELEGY FOR THE ARCTIC* (2016) – LUDOVICO EINAUDI

SCIENCE
An Introduction to Environmental Science

I. FOUNDATIONS OF ENVIRONMENTAL SCIENCE 20%
- A. What Is Environmental Science?
- B. Environmental Indicators
  1. Biological Diversity
  2. World Human Population
  3. Food Production
  4. Resource Consumption
  5. Global Temperatures and Greenhouse Gases
  6. Environmental Science Case Study: Measuring Greenhouse Gasses in Ice
  7. Air and Water Pollution
- C. The Scientific Method
  1. An Illustration of the Scientific Method
  2. The Role of Repetition in Science
  3. Understanding How to Interpret Scientific Studies
- D. The Limitations of Environmental Science
  1. The One Earth Problem
  2. Inconsistent Units of Measure for Energy
  3. Subjectivity
  4. Unpredictable Consequences of Preferences and Policies
- E. Environmental Systems
  1. System Dynamics
  2. Matter and Energy Exchange
  3. Open and Closed Systems
  4. The Human Component of Environmental Systems
  5. Inputs, Outputs, and Flux
  6. Steady State
  7. Environmental Science Case Study: Mono Lake—An Input–Output System Analysis
  8. Mean Residence Time
  9. Accumulation and Depletion
  10. Feedbacks
  11. Overshoot
  12. Regulating Population Systems
  13. Environmental Science Case Study: Humans and Elephants in Africa—Feedback and Regulation in Interacting Population Systems
  14. Environmental Science Case Study: Red Spruce in the Northeastern United States—An Environmental System Impacted by the Interaction of Natural and Human-Caused Factors
  15. Environmental Science Case Study: Managing Environmental Systems in the Florida Everglades

II. BIODIVERSITY: FROM LOCAL TO GLOBAL 30%
- A. Biodiversity
  1. What Is Biodiversity and Why Does It Matter?
  2. The Value of Biodiversity

3. Genetic Diversity
    a. Expressions of Genetic Diversity
    b. Species Diversity

B. Evolution
1. Adaptation through Natural Selection
2. Adaptation to a Changing Environment
3. Nonadaptive Evolutionary Processes
4. The Pace of Evolution

C. Changes in Environmental Conditions and Extinctions
1. The Fossil Record
2. Mass Extinctions
3. Estimating Extinction Rates from Habitat Loss

D. Human Activity and Biodiversity
1. Habitat Fragmentation
2. The Introduction of Exotic Species

E. Linking Biodiversity and Evolution to Ecology
1. The Ecological Perspective
2. Environmental Conditions
3. Resources

F. Population Ecology
1. Density-Dependent Growth
2. The Logistic Growth Model
3. ENVIRONMENTAL SCIENCE CASE STUDY: THE CHALLENGE OF MANAGING POPULATION GROWTH
4. Density-Independent Growth
5. Metapopulations
6. Populations and Biodiversity

G. Community Ecology
1. Interspecific Competition
2. Predation
3. Mutualism

H. Ecological Communities
1. Food Webs
2. Keystone Species
3. Succession
4. ENVIRONMENTAL SCIENCE CASE STUDY: A SIMPLE ECOSYSTEM—ORGAN CAVE

I. Productivity
1. Primary Productivity
2. Energy Transfer Efficiency

J. Major Aspects of Ecosystems
1. Ecosystem Boundaries
2. The Biotic Components of Ecosystems
3. The Impact of Ecosystem Change on Its Biotic Components

K. Biomes
1. The Global Climate and Biomes
2. Biomes and Global Biodiversity

L. The Cycle of Elements within the Biosphere
1. The Elements on Earth
2. Biogeochemical Cycles

3. The Hydrologic Cycle
4. The Carbon Cycle
5. The Nitrogen Cycle

III. THE HUMAN IMPACT ON NATURAL RESOURCES 30%
A. The Human Population
1. Growth Rate
2. Lower- and Higher-Income Countries
3. Population Size and Resource Use
4. Factors Affecting Population Growth
a. Fertility
b. Life Expectancy and Infant Mortality
5. Age Structure
B. The Elements on Earth
1. The Cycles of Calcium, Magnesium, Potassium, and Sulfur
2. Soil
a. What Is Soil?
b. Soil Horizons
c. State Variables and Soil Formation
d. Soil Degradation
C. Water Resources
1. The Long-standing Challenge of Accessing Clean Water
2. Water's Importance to Earth's Environmental and Human Systems
3. Groundwater and Surface Water: The Major Sources of Water for Human Use
4. Transport of Water
5. Desalination
6. Water Use
7. Water Shortages
8. Floods
9. Water Pollution
a. Types of Water Pollutants
b. Nonchemical Pollutants
c. Ocean and Shoreline Pollution
d. Solid Waste Pollution
e. Wastewater Treatment
10. Improvements in U.S. Water Quality
D. Agricultural Resources
1. The Beginnings of Agriculture
2. Traditional Agricultural Methods
3. The Green Revolution
4. The Status of World Food Production
5. Food Insecurity—Hunger in the World
6. Conventional Land-Use and Planting Techniques
a. Mechanization and Intensive Working of the Soil
b. Irrigation
c. Monocultures
d. Chemical Fertilizers
e. Chemical Pesticides

7. High-Density Farming of Animals
8. GMOs
    a. Genetic Engineering
    b. The GMO Controversy
9. Sustainable Agriculture

E. Fishery Resources
1. Overfishing and the Decline of Fisheries
2. The Scientific Management of Fisheries
3. Managing Fisheries for a Sustainable Future
4. An Economic Approach to Fishery Management
5. Integrating an Ecological Perspective into Fishery Management
6. ENVIRONMENTAL SCIENCE CASE STUDY: MANAGING AN ENDANGERED FISHERY

F. Forestry Resources
1. Principles of Forestry
2. Harvesting Methods
3. Intensive Forestry
4. Ecologically Sustainable Forestry
5. Forestry in the Tropics
6. ENVIRONMENTAL SCIENCE CASE STUDY: SELECTIVE LOGGING AND BUTTERFLY DIVERSITY IN BORNEO
7. North American Forests

IV. SCIENCE FOR A SUSTAINABLE FUTURE 20%

A. Air Pollution and Atmospheric Science
1. Major Air Pollutants
    a. Sulfur Dioxide
    b. Nitrogen Oxides
    c. Carbon Monoxide
    d. Lead
    e. Particulate Matter
    f. Ground-Level Ozone
2. Secondary Pollutants
3. Natural Sources of Air Pollution
4. Therman Inversion
5. ENVIRONMENTAL CASE STUDY: USING MODELS TO PREDICT POLLUTION

B. Energy Use and Sources
1. Units of Energy
2. Worldwide Patterns of Energy Use
3. The Current Fuel Mix in the United States
4. Energy Efficiency
5. Energy for Transportation
6. Finding the Right Energy Source for the Job
7. Generating Electricity
    a. The Power Grid
8. Nonrenewable Energy Sources
    a. Coal
    b. Petroleum
    c. Oil

d. Natural Gas
e. Hydraulic Fracturing
f. Nuclear Power
i. Nuclear Accidents
ii. Radioactive Waste
9. Renewable Energy
a. Direct and Indirect Solar Energy
b. Passive Solar Energy
c. Active Solar Energy
i. Solar Water Heating
ii. Solar Generation of Electricity
d. Wind Energy
e. Advantages and Disadvantages of Solar and Wind Energy
f. Hydroelectric Power
i. Run-of-the-River Hydro
ii. Water Impoundment
g. Biomass Around the World
h. Modern Carbon vs. Fossil Carbon
i. Ethanol
j. Geothermal and Tidal Energy
10. Conservation and Efficiency
a. Reducing Peak Demand

C. Human Environmental Impacts and Human Health Risks
1. Qualitative and Quantitative Risk Assessment
2. Environmental Risk Analysis
3. Risk Assessment
4. Environmental Science Case Study: Risk Assessment
5. Risk Acceptance
6. Risk Management

D. Global Climate Change
1. The Sun−Earth Heating System
2. Greenhouse Gases
3. Evidence of Temperature Change over Time
4. Indicators of Climate Change
5. Models
6. Feedback in the Global Greenhouse System
a. The Temperature−CO_2 Feedback Loop
b. The Temperature−Permafrost Feedback Cycle
c. The Ice−Albedo Feedback
7. Effects of Global Warming
8. Predicted Future Effects of Global Warming

SOCIAL SCIENCE
Climate Change in the Past and Present

I. CONCEPTUALIZING CLIMATE CHANGE IN THE PAST AND THE PRESENT 25%
- A. Essential Concepts from Earth System Science (ESS)
  - 1. The Earth's Subsystems
    - a. Geosphere
    - b. Hydrosphere
    - c. Atmosphere
    - d. Biosphere
  - 2. Forcings
    - a. Solar Energy
    - b. Volcanoes
    - c. Greenhouse Gases
  - 3. Positive and Negative Feedbacks
    - a. Examples of Positive Feedbacks
    - b. Examples of Negative Feedbacks
- B. Sources for Reconstructing the History of Climate
  - 1. The Archives of Nature
    - a. Ice Cores
    - b. Trees
    - c. Sedimentation and Other Sources
  - 2. The Archives of Society
    - a. Instrumental Records
    - b. Narrative Records
    - c. Other Types of Records
- C. Fields for Studying the History of Climate
  - 1. Historical Climatology and Paleoclimatology
  - 2. Climate History
  - 3. The History of Climate and Society (HCS)
- D. Conceptualizing Climate Change Today
  - 1. Concerns about Using the Term "Anthropocene"
  - 2. Arguments for Using the Term "Anthropocene"
- E. Climate Change and Narratives of Global History
  - 1. Mapping Climate onto Existing Narratives
  - 2. Climate Determinism and the Question of Causal Relationships
    - a. Multiple Scales
    - b. Incongruent Chronological Scales
    - c. The Novelty of the Anthropocene

II. HUMANS IN THE HOLOCENE 25%
- A. An Overview of the Holocene
  - 1. The End of the Last Ice Age and the Early Holocene
  - 2. The Middle Holocene
  - 3. The Late Holocene
- B. Climate and the Development of Human Civilizations
  - 1. Early Agrarian Societies

a. Mesopotamia
b. Egypt
c. India
d. The Americas
2. The Mediterranean World During Antiquity
3. 536 CE: The Worst Year to Be Alive?
4. The Climate in China and the Mandate of Heaven

C. The Little Ice Age (LIA) and the Colonial World
1. Phases of the LIA
2. The LIA around the Globe
a. European Empires
b. Africa
c. Asia
d. North America

D. From the "Seventeenth-Century Crisis" to the Nineteenth Century

III. THE ANTHROPOCENE 25%

A. The Origins of the Anthropocene
1. The Industrial Revolution and the Burning of Fossil Fuels
2. The "Great Acceleration" and the Beginning of the Anthropocene

B. The Causes of the Anthropocene
1. Global Production of Greenhouse Gases
2. The History of Oil Extraction
3. Current Sources of Fossil Fuels
4. Historic Greenhouse Gas Emissions in the West
5. Global Greenhouse Gas Emissions

C. The Consequences of the Anthropocene
1. Climate Change as Part of Compounding Ecological Crises
2. Stress on Human Habitats
a. Fires
b. Floods
c. Droughts
3. Stress on Human Life
a. Health
b. Financial Impacts
c. Migration
4. Impending Risks

IV. RESPONDING TO THE CLIMATE CRISIS 25%

A. Recognizing the Climate Crisis
1. Research Programs
a. The World Climate Research Program (WCRP)
b. The International Geosphere-Biosphere Programme (IGBP)
2. Raising Awareness of Climate Change
a. Early Public Warnings
b. The Intergovernmental Panel on Climate Change (IPCC)

B. Opposition to Climate Action
1. Nierenberg and the Marshall Institute

2. U.S. Opposition to the Kyoto Protocol
3. Business and Industry
4. Political Parties
5. News Media

C. Mitigating the Climate Crisis
1. Political Efforts
a. The United Nations Framework Convention on Climate Change (UNFCCC)
b. The Kyoto Protocol
c. The Paris Agreement
d. The Green New Deal and Inflation Reduction Act (IRA)
2. New Technology and Industry
3. Geoengineering
4. New Sources of Energy

D. Climate Activism
1. Speaking Out for “Climate Justice”
2. Standing Rock and Indigenous Voices
3. Fridays for Future and Youth Voices