

ART

The Confluences of Water and 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. EAST ASIAN INK WASH PAINTING 14%
- A. Introduction to Ink Wash Technique
 - B. The Rise of Chinese Ink Painting
 - C. Art of the Yuan Dynasty, 1279–1368
 - 1. SELECTED WORK: *FISHERMEN, AFTER JING HAO*, WU ZHEN, c.1341
 - D. Japanese Zen Painting
 - 1. SELECTED WORK: *GIBBONS IN A LANDSCAPE*, SESSON SHŪKEI, c.1570
 - E. Korean Ink Painting Traditions
 - 1. SELECTED WORK: *ORCHID AND ROCK*, KIM ŬNG-WŎN, LATE NINETEENTH–EARLY TWENTIETH CENTURY
 - F. Contemporary Korean Ink Painting
- III. THE WATERCOLOR IN WESTERN ART 22%
- A. The Development of Watercolor as a Medium in Western Art
 - 1. SELECTED WORK: *THE LARGE PIECE OF TURF*, ALBRECHT DÜRER, 1503
 - B. Watercolor and Natural History Illustration
 - 1. SELECTED WORK: *GOLDEN EAGLE (AQUILA CHRISTAETOS) STUDY FOR HAVELL, PL. 181*, JOHN JAMES AUDUBON, 1833
 - C. British Watercolor and Children’s Book Illustration
 - 1. SELECTED WORK: *TWO GENTLEMAN RABBITS IN THE SNOW*, BEATRIX POTTER, c.1890
 - D. The Rise of Nineteenth-Century American Watercolor
 - 1. SELECTED WORK: *THE GULF STREAM*, WINSLOW HOMER, PROBABLY 1899 (DATED BY THE ARTIST “1889”)
 - 2. SELECTED WORK: *HASKELL’S HOUSE*, EDWARD HOPPER, 1924
- IV. WATER AS SUBJECT 22%
- A. Water as Subject Matter and Its Social and Political Implications
 - B. SELECTED WORK: *UNDER THE WAVE OFF KANAGAWA*, ALSO KNOWN AS *THE GREAT WAVE*, KATSUSHIKA HOKUSAI, c.1830/33
 - C. SELECTED WORK: *WATSON AND THE SHARK*, JOHN SINGLETON COPLEY, 1778
 - D. SELECTED WORK: *NIAGARA*, GEORGE INNESS, 1889
 - E. History of Niagara Falls Imagery
 - F. SELECTED WORK: *BLACK LAVA BRIDGE, HANA COAST No. 1*, GEORGIA O’KEEFFE, 1939
 - G. SELECTED WORK: *STRUGGLE SERIES No. 10 – WASHINGTON CROSSING THE DELAWARE*, JACOB LAWRENCE, 1954
- V. WATER IN ARCHITECTURE, SCULPTURE, AND ENVIRONMENTAL ART 22%
- A. Water as a Feature in Modern Art and Architecture
 - B. SELECTED WORK: *MEETING OF THE WATERS*, ST. LOUIS, MISSOURI, CARL MILLES, 1931–39
 - C. SELECTED WORK: *FALLINGWATER*, MILL RUN PENNSYLVANIA, FRANK LLOYD WRIGHT, 1935
 - D. SELECTED WORK: *MAMI WATA FIGURE*, IGBO ETHNIC GROUP, 1950s
 - E. SELECTED WORK: *SPIRAL JETTY*, GREAT SALT LAKE, UTAH, ROBERT SMITHSON, 1970
 - F. SELECTED WORK: *ICE WATCH*, LONDON, ENGLAND, OLAFUR ELIASSON AND MINIK ROSING, 2018

ECONOMICS

An Introduction to Economics and the Economics of the Water

- 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. THE ECONOMICS OF WATER

20%

- A. The Basics
 - 1. Users
 - 2. Water Sources
 - 3. Water Quantity
 - 4. Water Quality

5. Case Study: China's South-North Water Transfer Project
- B. Supply and Demand
 1. Water Supply
 2. Water Pricing
 3. Consumer Water Demand
 4. Case Study: Pumping and Subsidies in India
- C. Water and Agriculture
 1. The History of Irrigation
 2. Irrigation Organizations
 3. Case Study: The Value of Irrigation in the United States
 4. Water Conservation
- D. Water Property Rights
 1. Water Law
 2. Riparian Doctrine
 3. Prior Appropriation
 4. Case Study: Saline Lake Depletion
 5. Groundwater Rights
- E. Water Quantity Markets
 1. Basics
 2. Water Transfers
 3. Environmental Transfers
 4. Case Study: Extreme Water Scarcity in Chile
- F. Water Pollution
 1. Externalities and Water Quality
 2. Case Study: Cleaning Up Coal Ash
 3. Water Quality Regulation
 4. The Clean Water Act
 5. Case Study: Invasive Species in the Great Lakes
- G. Drinking Water
 1. Access to Drinking Water
 2. Case Study: The Flint Water Crisis
- H. Water Quality Markets
 1. Market Instruments
 2. Water Quality Trading in Practice
 3. Case Study: North Carolina

LITERATURE

Water: An Enduring Element in 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. WATER, WATER EVERYWHERE: A PERSISTENT THEME 10%
 - A. Historical Overview: The Stories of Water
 - 1. Ancient Times and the Middle Ages
 - 2. The Age of Discovery
 - 3. The Eighteenth Century
 - 4. The Nineteenth Century
 - 5. The Twentieth Century
 - 6. The Twenty-First Century
 - 7. A Diversity of Texts
 - B. Recurrent Themes and Symbols: The Meaning of Water
 - 1. Destruction
 - 2. Purity and Purification
 - 3. Depth and the Unknown
 - 4. Movement
 - 5. Revelation and Release

- III. JACK LONDON'S *THE SEA-WOLF* 40%
 - A. Genre: A Historical Overview of Nautical Fiction
 - 1. Masculinity
 - 2. Class Issues
 - 3. Industry and Capitalism
 - 4. Issues of Race
 - B. A Superb Meteor: The Life and Adventures of Jack London
 - C. Plot and Structure: Summarizing *The Sea-Wolf*
 - D. Historical Context: The Clubs of Inspiration for *The Sea-Wolf*
 - 1. Personal Context: London Among the Sailors
 - 2. Historical Context: Early Industrial Setting
 - 3. Philosophical and Scientific Context: Existential Inspiration
 - a. The Influence of Nietzsche
 - b. The Influence of Schopenhauer
 - c. The Influence of Darwin and Spencer

4. Literary Context: Realism and Naturalism
- E. Characters: Key Players in *The Sea-Wolf*
 1. Humphrey Van Weyden
 2. Captain Wolf Larsen
 3. Maud Brewster
 4. The Seamen
- F. Themes: Persistent Motifs in *The Sea-Wolf*
 1. Philosophy, Evolution, and the Nature of Man
 2. Masculinity and Femininity
 3. Capitalism and Class Struggle
 4. Fairness and Determinism
- G. Water: A Most Necessary Part of *The Sea-Wolf*
 1. Setting
 2. Imagery
 3. Symbolism
 4. Style and Genre

IV. SHORTER SELECTIONS 35%

- A. Fiction: Flannery O'Connor's "The River" (1955)
 1. Flannery O'Connor's Biography and Background
 2. SELECTED WORK: "THE RIVER" BY FLANNERY O'CONNOR
 3. Analysis of Flannery O'Connor's "The River"
- B. Fiction: John Cheever's "The Swimmer" (1964)
 1. John Cheever's Biography and Background
 2. SELECTED WORK: "THE SWIMMER" BY JOHN CHEEVER
 3. Analysis of John Cheever's "The Swimmer"
- C. Fiction: Neil Gaiman's "Down to a Sunless Sea" (2013)
 1. Neil Gaiman's Biography and Background
 2. SELECTED WORK: "DOWN TO A SUNLESS SEA" BY NEIL GAIMAN
 3. Analysis of Neil Gaiman's "Down to a Sunless Sea"
- D. Poetry: Sterling Brown's "Children of the Mississippi" (1932)
 1. Sterling Brown's Biography
 2. Background
 3. SELECTED WORK: "CHILDREN OF THE MISSISSIPPI" BY STERLING BROWN
 4. Analysis of Sterling Brown's "Children of the Mississippi"
- E. Poetry: Askia Touré's "Floodtide" (1963)
 1. Askia Touré's Biography
 2. Background
 3. SELECTED WORK: ASKIA TOURÉ'S "FLOODTIDE"
 4. Analysis of Askia M. Touré's "Floodtide"
- F. Poetry: Adrienne Rich's "Diving into the Wreck" (1973)
 1. Adrienne Rich's Biography and Background
 2. SELECTED WORK: "DIVING INTO THE WRECK" BY ADRIENNE RICH
 3. Analysis of Adrienne Rich's "Diving into the Wreck"
- G. Poetry: David Slavitt's "Titanic" (1983)
 1. David Slavitt's Biography

2. Background
 3. SELECTED WORK: DAVID SLAVITT'S "TITANIC"
 4. Analysis of David Slavitt's "Titanic"
- H. Poetry: Derek Mahon's "After the Titanic" (1985)
1. Derek Mahon's Biography
 2. Background
 3. SELECTED WORK: DEREK MAHON'S "AFTER THE TITANIC"
 4. Analysis of Derek Mahon's "After the Titanic"
- I. Poetry: Tarfia Faizullah's "I Told the Water" (2016)
1. Tarfia Faizullah's Biography
 2. Background
 3. SELECTED WORK: TARFIA FAIZULLAH'S "I TOLD THE WATER"
 4. Analysis of Tarfia Faizullah's "I Told the Water"
- J. Poetry: Natalie Diaz's "The First Water Is the Body" (2020)
1. Natalie Diaz's Biography
 2. Background
 3. SELECTED WORK: NATALIE DIAZ'S "THE FIRST WATER IS THE BODY"
 4. Analysis of Natalie Diaz's "The First Water Is the Body"

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

The Intersections of Music and Water

- 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 Partial
 - 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. RELYING ON WATER 18%

- A. Life (and Music) Underwater
- B. Instruments Need Water, Too
 - 1. From Around the World
 - a. Water Drums from Africa
 - b. Water Drums from the Americas
 - c. "Water Waves" and Glass Harps
 - d. Musical Glasses from Europe
 - 2. American-Made (But Not in America)

- a. The Mariannes and Mozart
- b. LISTENING COMPANION 1: *ADAGIO IN C FOR GLASS ARMONICA*, K. 356 (K⁶ 617A) (1791) – WOLFGANG AMADEUS MOZART
- 3. From the Ancients to the Moderns
 - a. The Hydraulis
 - b. The Water Organ
 - c. Joshua Stoddard and the Calliope
 - d. Steve Mann and the Hydraulophone
 - e. More Mann, Terje Isungset, and Ice Music
 - f. Tan Dun and the *Water Concerto*
- C. Water Workers
 - 1. Singing While A-Sail
 - a. The Allure of Sea Songs
 - b. Hauling via Shanties
 - c. LISTENING COMPANION 2: “HAUL AWAY THE BOWLINE” (16TH CENTURY?) – ANONYMOUS
 - 2. Working the Waterways
 - 3. Music for Passengers
 - a. Gondola! Gondola!
 - b. “The” Water Music
 - c. Floating Entertainment

III. WATER, CONTAINED 10%

- A. The Sound of Water: Fountains
 - 1. New Instrument = New Genre
 - 2. Picturing Water
 - 3. If It’s Ravel, It’s Swell
 - a. LISTENING COMPANION 3: *JEUX D’EAU* (1901) – MAURICE RAVEL
- B. The Sound of Water: Aquariums
 - 1. Saint-Saëns’s Love-Hate Relationship
 - a. LISTENING COMPANION 4: *THE CARNIVAL OF THE ANIMALS*, MVT. VII “AQUARIUM” (1886) – CAMILLE SAINT-SAËNS

IV. WATER, LESS RESTRAINED 10%

- A. The Sound of Water: Oceans
 - 1. The Symphonic Seas
 - 2. “Modern” Oceans
 - 3. Adding Aquatic Voices
 - 4. A Song for *All* Seas
 - a. LISTENING COMPANION 5: *A SEA SYMPHONY* (SYMPHONY NO. 1), MVT. I (EXCERPT) (1909) – RALPH VAUGHAN WILLIAMS
- B. The Sound of Water: Lakes
 - 1. Land of 10,000 Lakes
 - a. LISTENING COMPANION 6: *SYMPHONY: WATER MUSIC*, MVT. III “WAFTING” (1985) – LIBBY LARSEN

V. WATER WITH IDENTITY 18%

A. Water We Know: The Moldau

1. Two Names, One River

- a. LISTENING COMPANION 7: *MÁ VLAST*, “VLTAVA” (“THE MOLDAU”) (EXCERPT)
(1874) – BEDŘICH SMETANA

B. Water We Know: The Yellow River

1. Changing Directions

2. Water With (and Without) Words

- a. LISTENING COMPANION 8: *YELLOW RIVER PIANO CONCERTO*, MVT. 1 “PRELUDE:
THE SONG OF THE YELLOW RIVER BOATMAN” (1969) – XIAN XINGHAI; ARR. YIN
CHENGZONG ET AL.

C. Water We Know: The Mississippi

1. Making Musicals Meaningful

- a. LISTENING COMPANION 9: *SHOW BOAT*, “OL’ MAN RIVER” (1927) – JEROME KERN

D. Personifying Water

1. A Poetic Journey

- a. LISTENING COMPANION 10: *DIE SCHÖNE MÜLLERIN*, D. 795, No. 20 “DES BACHES
WIEGENLIED” (“THE BROOK’S LULLABY”) (1823) – FRANZ SCHUBERT

VI. WATER IN OTHER GUISES 12%

A. Music and Rain

1. Singing in the Rain
2. Rain in the Concert Hall
3. Stormy Weather

B. Music and Frozen Water

1. The Snowy Piano

- a. LISTENING COMPANION 11: *CHILDREN’S CORNER*, “THE SNOW IS DANCING” (1908)
– CLAUDE DEBUSSY

C. Music and Water Vapor

1. Knock Three Times
2. I Got S-S-Steam Heat

- a. LISTENING COMPANION 12: *THE PAJAMA GAME*, “STEAM HEAT” (1954) – RICHARD
ADLER

VII. WATER AS SYMBOL 12%

A. Symbolic Water: Patriotism

B. Symbolic Water: Religion

1. Remembering Baptism

- a. LISTENING COMPANION 13: *OLD AMERICAN SONGS*, SET II, “AT THE RIVER” (1952)
– ROBERT LOWRY; ARR. AARON COPLAND

C. Symbolic Water: The Underground Railroad

1. Text and Subtext
2. Salvation of Another Sort

- a. LISTENING COMPANION 14: “WADE IN THE WATER” (19TH CENTURY) –
ANONYMOUS; ARR. PAUL T. KWAMI

SCIENCE

An Introduction to Marine Biology

- I. THE OCEAN PLANET 40%
 - A. An Introduction to Marine Biology
 - 1. What Is Marine Biology?
 - 2. The History of Marine Biology and Oceanography
 - 3. Modern Marine Biology and Oceanography
 - B. How Do We Study Marine Life?
 - 1. The Scientific Method
 - C. The Geography and Geology of the Ocean
 - 1. Ocean Basin Geography
 - 2. The Formation of the Earth and the Ocean
 - 3. The Ocean Floor and Plate Tectonics
 - 4. The Formation of the Basins
 - 5. Marine Provinces
 - a. Continental Margins
 - b. The Deep-Sea Floor
 - 6. Biological Provinces
 - D. Water and Seawater
 - 1. The Chemical and Physical Properties of Water
 - 2. Seawater
 - 3. Dissolved Gases in Seawater
 - E. Sediments
 - 1. The Classification of Sediments
 - 2. The Study and Economic Impact of Sediments
 - F. Interactions of the Ocean and the Atmosphere
 - 1. Atmospheric Circulation
 - 2. Oceanic Circulation
 - G. Waves
 - 1. Wave Anatomy
 - 2. Wave Classification
 - 3. Wave Generation
 - 4. Tsunamis
 - H. Tides
 - 1. Lunar Tides
 - 2. Solar Tides
 - 3. Tidal Patterns
 - 4. Tidal Patterns and Marine Organisms
 - 5. Energy from Tides
- II. MARINE LIFE 40%
 - A. The Origins of Life
 - B. Defining Marine Life

- C. The Building Blocks of Life
- D. Photosynthesis and Chemosynthesis
 - 1. The Fuel of Life
- E. Biogeochemical Cycles
 - 1. The Carbon Cycle
 - 2. The Nitrogen Cycle
 - 3. The Phosphorous Cycle
- F. Classifying Marine Life
 - 1. The Tree of Life
- G. The Microbial World
 - 1. Viruses
 - 2. Bacteria
 - 3. Archaea
 - 4. Unicellular Algae
 - 5. Protozoans
- H. Plankton
 - 1. Phytoplankton
 - 2. Zooplankton
- I. Seaweeds and Plants
 - 1. Seaweeds
 - 2. Flowering Plants
 - 3. Salt Marsh Plants
 - 4. Mangroves
- J. Invertebrates: Animals without a Backbone
 - 1. Sponges
 - 2. Gelatinous Animals
 - 3. Worms
 - 4. Molluscs
 - 5. Arthropods
 - 6. Echinoderms
 - 7. Tunicates and Cephalochordates
- K. Vertebrates
 - 1. Jawless Fishes
 - 2. Cartilaginous Fishes
 - 3. Bony Fishes
 - 4. Marine Reptiles
 - 5. Marine Birds
 - 6. Marine Mammals

III. MARINE ECOSYSTEMS 10%

- A. What Is Marine Ecology?
- B. Environmental Factors Limiting Organismal Distribution
- C. Ecological Principles
- D. Habitats
 - 1. The Intertidal Zone
 - 2. Seaweed Communities

3. Estuaries and Salt Marshes
 4. Coral Reefs
 5. The Open Ocean
 6. The Deep-Sea
- E. Feeding and Food Webs

IV. HUMANS AND THE OCEAN 10%

- A. Resources from the Ocean
1. Living Resources
 2. Nonliving Resources
- B. Anthropogenic Impacts
1. Marine Pollution
 2. Eutrophication
 3. Habitat Modification
 4. Overfishing
 5. Introduced Species
 6. Climate Change Impacts on the Oceans
- C. Conservation and Protection
1. Marine Protected Areas
 2. Habitat Restoration

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 - E. Sediments
 - 1. The Classification of Sediments
 - 2. The Study and Economic Impact of Sediments
 - F. Interactions of the Ocean and the Atmosphere
 - 1. Atmospheric Circulation
 - 2. Oceanic Circulation
 - G. Waves
 - 1. Wave Anatomy
 - 2. Wave Classification
 - 3. Wave Generation
 - 4. Tsunamis
 - H. Tides
 - 1. Lunar Tides
 - 2. Solar Tides
 - 3. Tidal Patterns
 - 4. Tidal Patterns and Marine Organisms
 - 5. Energy from Tides
- II. MARINE LIFE 40%
 - A. The Origins of Life
 - B. Defining Marine Life

- C. The Building Blocks of Life
- D. Photosynthesis and Chemosynthesis
 - 1. The Fuel of Life
- E. Biogeochemical Cycles
 - 1. The Carbon Cycle
 - 2. The Nitrogen Cycle
 - 3. The Phosphorous Cycle
- F. Classifying Marine Life
 - 1. The Tree of Life
- G. The Microbial World
 - 1. Viruses
 - 2. Bacteria
 - 3. Archaea
 - 4. Unicellular Algae
 - 5. Protozoans
- H. Plankton
 - 1. Phytoplankton
 - 2. Zooplankton
- I. Seaweeds and Plants
 - 1. Seaweeds
 - 2. Flowering Plants
 - 3. Salt Marsh Plants
 - 4. Mangroves
- J. Invertebrates: Animals without a Backbone
 - 1. Sponges
 - 2. Gelatinous Animals
 - 3. Worms
 - 4. Molluscs
 - 5. Arthropods
 - 6. Echinoderms
 - 7. Tunicates and Cephalochordates
- K. Vertebrates
 - 1. Jawless Fishes
 - 2. Cartilaginous Fishes
 - 3. Bony Fishes
 - 4. Marine Reptiles
 - 5. Marine Birds
 - 6. Marine Mammals

III. MARINE ECOSYSTEMS 10%

- A. What Is Marine Ecology?
- B. Environmental Factors Limiting Organismal Distribution
- C. Ecological Principles
- D. Habitats
 - 1. The Intertidal Zone
 - 2. Seaweed Communities

3. Estuaries and Salt Marshes
 4. Coral Reefs
 5. The Open Ocean
 6. The Deep-Sea
- E. Feeding and Food Webs

IV. HUMANS AND THE OCEAN 10%

- A. Resources from the Ocean
 1. Living Resources
 2. Nonliving Resources
- B. Anthropogenic Impacts
 1. Marine Pollution
 2. Eutrophication
 3. Habitat Modification
 4. Overfishing
 5. Introduced Species
 6. Climate Change Impacts on the Oceans
- C. Conservation and Protection
 1. Marine Protected Areas
 2. Habitat Restoration

SOCIAL SCIENCE

Water Is Life, Water Is Power: Water's Role in Human History

1. PHYSICAL PROPERTIES OF WATER 5%
 - A. Chemical and Atmospheric Properties of Water
 - B. Biochemical Properties of Water

- II. THE ENVIRONMENTAL HISTORY OF WATER 55%
 - A. Water and Pastoralist Cultures
 1. Mongol Culture and Water
 2. Bedouin Culture and Water
 3. Maasai Culture and Water
 4. The First Nations of Eastern North America
 - B. The Great Transition: Water and the Neolithic Revolution
 1. The Neolithic Revolution in Southwest Asia, China, and Mesoamerica
 - a. Southwest Asia
 - b. China
 - c. Mesoamerica
 - d. The Expansion of Arable Land in Southwest Asia
 2. The Meaning and Role of Water in the First Urban Civilizations: Mesopotamia and Egypt
 - a. Mesopotamia
 - b. Egypt
 - c. Religious Beliefs
 3. A Second Comparison: China and the Indus River Civilization
 - a. China
 - b. The Indus River Civilization
 - c. Water and Early Agricultural Societies
 - C. The Wittfogel Thesis
 - D. The "Great Goddess" Hypothesis
 - E. The Role of Water in European Antiquity
 1. Water Usage and Problems in Ancient Greece
 2. Water in Ancient Greek Culture
 3. Water Use and Problems in Ancient Rome
 4. Water as a Factor in Roman Imperial Expansion and Collapse
 - F. The Second Great Transition: Urbanization and the Industrial Revolution
 1. Prologue: Water Management in Medieval China
 2. Water Management and the Growth of Early Modern Cities in Europe
 - a. Canals
 - b. Windmills
 - c. The Modern Period
 - d. Case Study: The Low Countries
 - e. Case Study: England
 - f. Case Study: Germany

3. Water as a Power Source: The Concept of Energy System Transitions
 - a. The Los Angeles Aqueduct
 - b. Soviet Management of the Aral Sea
 - c. The Growth of Hydroelectric Power
 - d. Case Study: The Piave River
 - e. Case Study: The Merrimack River
 - f. The LMEST and Canal Construction
 - g. Other Impacts of the LMEST
4. Industrial Water Technology in Global Applications
 - a. Case Study: Egypt, Revisited
 - b. Case Study: The Indus River Valley, Revisited
 - c. Case Study: China, Revisited

III. PRESENT-DAY WATER ISSUES 20%

- A. A Miniature History of Waterborne Diseases
- B. The Sanitary Revolution
- C. Water in the Industrialized World: The United States
 1. Drinking Water
 2. Bottled Water
 3. Sewer Systems
- D. Water in the Industrializing World: China
- E. Water in the Rural Global South
- F. Water in the Urban Global South—The Example of Bolivia
- G. Water and Agriculture
 1. The Ogallala Aquifer
 2. The Desert Southwest
 3. The Arabian Aquifer System
 4. Eutrophication
- H. Oceanic Water
 1. Saltwater Eutrophication
 2. Nonorganic Waste and Bioconcentration
 3. Pollution from the Transport of Oil
 4. The Great Pacific Garbage Patch

IV. WATER AND THE FUTURE OF HUMAN CIVILIZATION 20%

- A. Response to Scarcity, Example 1: Conservation and Reuse in Israel
- B. Response to Scarcity, Example 2: Desalinization in California
- C. Response to Scarcity, Example 3: Unusual Approaches
 1. The Proposed Rerouting of Siberian Rivers
 2. Operation Plowshare
 3. The South-North Water Transfer Project
 4. Iceberg Towing
 5. Other Possibilities
- D. Climate Change, International Relations, and Water
 1. The Rio Grande and the Colorado Rivers
 2. The Nu/Thanlwin/Salween River

3. Lake Victoria
4. Subsurface Aquifers
 - a. The Nubian Sandstone Aquifer
 - b. The Guarani Aquifer
5. The Convention on Long-Range Transboundary Air Pollution (LRTAP)