

APES STUDY GUIDE

Test Date: _____

- **Topics:**
 - I. Earth Systems and Resources (10–15%)
 - II. The Living World (10–15%)
 - III. Population (10–15%)
 - IV. Land and Water Use (10–15%)
 - V. Energy Resources and Consumption (10–15%)
 - VI. Pollution (25–30%)
 - VII. Global Change (10–15%)

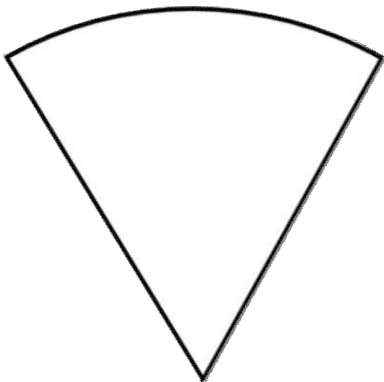
A. Earth Science Concepts

- **Geological Time Scale:** Define and identify the current one for each

- Eon
- Era
- Period
- Epoch
- Age

A. Earth Science Concepts

- **Earth Structure**- Diagram includes: crust (continental/oceanic), lithosphere, asthenosphere, mantle, inner core, outer core with a brief description of each



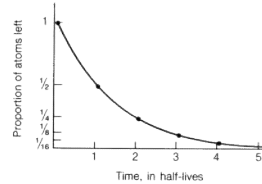
I. Earth Systems and Resources

- **A. Earth Science Concepts**
Geologic time scale; plate tectonics, earthquakes, volcanism; seasons; solar intensity and latitude
- **B. The Atmosphere**
Composition; structure; weather and climate; atmospheric circulation and the Coriolis Effect; atmosphere–ocean interactions; ENSO
- **C. Global Water Resources and Use**
Freshwater/saltwater; ocean circulation; agricultural, industrial, and domestic use; surface and groundwater issues; global problems; conservation
- **D. Soil and Soil Dynamics**
Rock cycle; formation; composition; physical and chemical properties; main soil types; erosion and other soil problems; soil conservation

A. Earth Science Concepts

- **Radiometric Dating:**
- **What is the half-life and usage of the following?**

- Carbon-14
- Uranium-238



- **Half Life Calculations**
 - If the half-life of 100.0 grams of a radioactive isotope is 8 years, how many grams will remain in 32 years?

A. Earth Science Concepts

- **Plate Tectonics** –
- **Continental Drift** –
- **Seafloor Spreading** –

A. Earth Science Concepts

- **Plates Boundaries** – describe, diagram and provide a real world example
 - Divergent

 - Convergent

 - Transform

A. Earth Science Concepts

- How do Earthquakes arise?

- **Body Waves:**
 - P Waves:
 - S Waves:
- **Surface Waves:**
 - Love Waves:
 - Rayleigh Waves:

A. Earth Science Concepts

- What is a Volcano?

- Describe the main types of volcano.

- What are the effects of volcanos?

A. Earth Science Concepts

- **Convection Currents**
 - What are convection currents in the mantle? Include a diagram.

 - What drives them?

 - How do these effect the Earth?

A. Earth Science Concepts

- What are Tsunamis?

- Where do they occur?

- How can they be detected?

A. Earth Science Concepts

- What are the factors that control seasons?

- What is the relationship between solar intensity and latitude?

B. The Atmosphere

- Composition of Atmosphere
 - main compounds, their formula & % composition

B. The Atmosphere

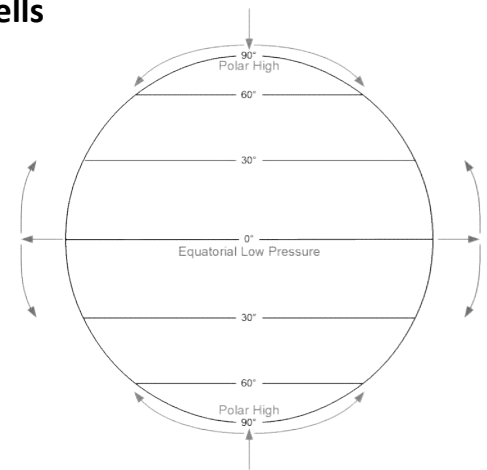
- Structure/Layers of Atmosphere (include major properties & diagram)

B. The Atmosphere

- Difference between weather and climate?
- Factors that influence climate-

B. The Atmosphere

- Air Circulation Cells



B. The Atmosphere

- What is the Coriolis Effect?
- How does the Coriolis Effect alter global winds?

B. The Atmosphere

- What is upwelling?
- What is a thermocline?
- El Niño (ENSO) vs La Niña

B. The Atmosphere

- Polar Vortex
- Hurricane
- Tornado
- Cyclone
- Monsoon

C. Global Water Resources and Use

- Percent Freshwater _____ Saltwater _____
- Where is the freshwater? Provide percentages for each.
- How is the water in the oceans circulated?
 - Surface Currents
 - Deep Water Currents / Thermohaline Circulation

C. Global Water Resources and Use

- What are some issues facing water resources?
 - Surface Issues
 - Ground Water Issues

C. Global Water Resources and Use

- Important Properties of Water
 - Solubility
 - Specific Heat
 - Adhesion
 - Cohesion
 - Density of Ice

C. Global Water Resources and Use

- List use & conservation of water in each sector.
 - Agricultural
 - Industrial
 - Domestic

C. Global Water Resources and Use

- Global Water Problems
 - Subsidence vs. Sinkhole
 - Saltwater Intrusion
 - Water Shortages
 - Dams

C. Global Water Resources and Use

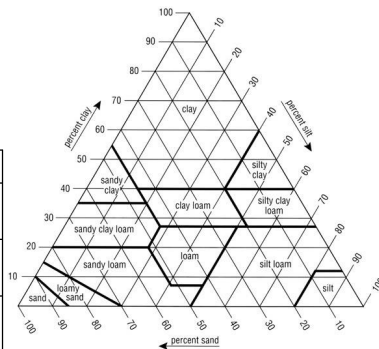
- **Water Case Studies**
 - Case Study: Ogallala Aquifer
 - Case Study: Mexico City
 - Case Study: Aswan High Dam
 - Case Study: California Water Project

D. Soil and Soil Dynamics

- **Soil Composition:**

- **Soil Triangle Problems:**

Clay	Sand	Silt	Texture
30	10	60	
60	30	10	
20	40	40	

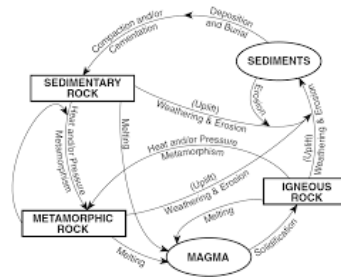


D. Soil and Soil Dynamics

- **Components of Soil Quality**
 - Aeration
 - Compaction
 - Permeability
 - pH
 - Nutrient-Holding
 - Water-Holding

D. Soil and Soil Dynamics

- **Rock Cycle** - formation/composition, physical & chemical properties



D. Soil and Soil Dynamics

- **Soil Horizons (identify & describe)**
 - O:
 - A:
 - E:
 - B:
 - C:
 - R:
- **Case Study: Dust Bowl**

D. Soil and Soil Dynamics

- **Soil Degradation: Define & Provide Solutions**
 - Desertification
 - Salinization
 - Waterlogging

D. Soil and Soil Dynamics

- What are the major ways we can conserve soil?

A. Ecosystem Structure

- Ecosystem Properties- Define & list examples
 - Abiotic factors

– Biotic factors

A. Ecosystem Structure

- What is a habitat?
- What are ecological niches?
- Difference between fundamental & realized niche

II. The Living World

A. Ecosystem Structure

Biological populations and communities; ecological niches; interactions among species; keystone species; species diversity and edge effects; major terrestrial & aquatic biomes

B. Energy Flow

Photosynthesis and cellular respiration; food webs and trophic levels; ecological pyramids

C. Ecosystem Diversity

Biodiversity; natural selection; evolution; ecosystem services

D. Natural Ecosystem Change

Climate shifts; species movement; ecological succession

E. Natural Biogeochemical Cycles

Water, Carbon, Nitrogen, Phosphorus, Sulfur, Conservation of Matter

A. Ecosystem Structure

- Levels of Organization (Species → Biosphere)

A. Ecosystem Structure

- Population Distribution
 - Clumped
 - Uniform
 - Random
- Population Density

A. Ecosystem Structure

- **Methods of measuring and sampling population:**
 - Population Density
 - Quadrat
 - Transects
 - Mark Recapture

A. Ecosystem Structure

- **Species Interactions** – describe & provide an example
 - Predation/Herbivory
 - Competition
 - Saprotrophism
 - Trophic Cascade

A. Ecosystem Structure

- **Predator/Prey Adaptations**
 - Coloration
 - Cryptic
 - Aposematic
 - Mimicry
 - Batesian
 - Mullerian

A. Ecosystem Structure

- **Species Interactions** – describe & provide an example
 - Commensalism
 - Ammensalism
 - Mutualism
 - Parasitism

A. Ecosystem Structure

- **Effects of Competition**
 - Competitive Exclusion
 - Resource Partitioning
 - Character Displacement

A. Ecosystem Structure

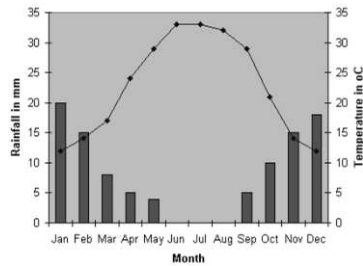
- **What are keystone species? List examples/why?**
- **What are foundation species? List examples/why?**
- **What are edge effects?**

A. Ecosystem Structure

- What are factors that determine different Biomes?

- **Reading a Climatograph**

(Describe Graph & Identify Biome Type)



A. Ecosystem Structure

- Aquatic Biomes
 - Wetlands
 - Coral Reefs
 - Lakes
 - Rivers & Stream

A. Ecosystem Structure

- Terrestrial Biomes – Major Properties
 - Chaparral
 - Temperate Grassland
 - Tundra
 - Desert

A. Ecosystem Structure

- Aquatic Biomes
 - Lentic vs Lotic
 - Zones of Freshwater/Lakes
 - Zones of Saltwater/Marine

A. Ecosystem Structure

- Terrestrial Biomes – Major Properties
 - Savanna
 - Boreal Forest/Taiga
 - Temperate Deciduous Forests
 - Temperate/Tropical Forests

A. Ecosystem Structure

- Terrestrial Biomes – Major Threats
 - Savanna
 - Boreal Forest/Taiga
 - Temperate Deciduous Forests
 - Temperate/Tropical Forests

A. Ecosystem Structure

- Terrestrial Biomes – Major Threats
 - Chaparral
 - Temperate Grassland
 - Tundra
 - Desert

B. Energy Flow

- What is the initial source(s) of all energy?
- Relationship between Photosynthesis and Cellular respiration (include equations)

C. Ecosystem Diversity

- What is Biomass?
- What is Productivity? How is it measured?
- Explain: $NPP = GPP - \text{Respiration}$

SYSTEM CHARACTERISTICS

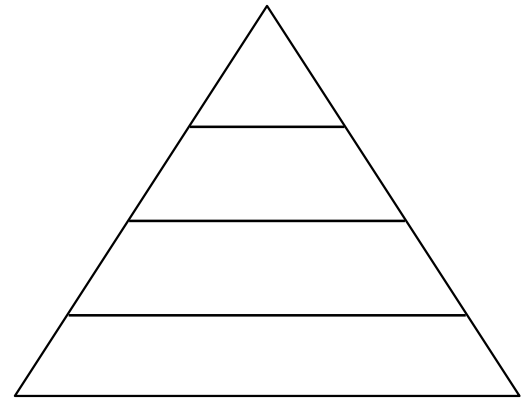
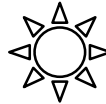
Feedback Loops- explain and give an example

- Positive (enhance flow)
- Negative (inhibit flow)

B. Energy Flow

Ecological Pyramids/Trophic Levels (label for each)

(be sure to label energy flow with percentage)



C. Ecosystem Diversity

- What is Biodiversity? (4 Components)
- How is it measured?

C. Ecosystem Diversity

- Relationship between Evolution & Natural Selection (provide an example)
- What is artificial selection?

C. Ecosystem Diversity

- Identify the major economic & ecosystem services of a specific ecosystem of your choice.

C. Ecosystem Diversity

- What is extinction?
- What is extirpation?
- What characteristics make species vulnerable to extinction?

D. Natural Ecosystem Change

- How can climate shifts impact ecosystems?
- What factors influence species movement?

D. Natural Ecosystem Change

Ecological Succession

- Primary Succession:
- Secondary Succession:

D. Natural Ecosystem Change

Ecological Succession

- Facilitation
- Tolerance
- Inhibition

D. Natural Ecosystem Change

- Characteristics of succession within plant communities-
 - structure
 - diversity
 - net primary productivity
 - nutrient cycling by decomposers
 - photosynthesis efficiency

E. Biogeochemical Cycle

- Explain the role of each in the human body
 - Water
 - Carbon
 - Nitrogen
 - Phosphorus
 - Sulfur

E. Biogeochemical Cycle: WATER

E. Biogeochemical Cycle

- Explain the statement: “Energy Flows, Matter Cycles”
- What is a reservoir?
- How does this relate to the idea of biosequestration?

E. Biogeochemical Cycle: WATER

Diagram on Blank Slide Should Include-

- Precipitation, Condensation, Evaporation, Transpiration, Infiltration, Percolation, Runoff, Surface Water, Groundwater
- What are some human impact on the water cycle?

E. Biogeochemical Cycle: CARBON

Diagram on Blank Slide Should Include-

- Release of carbon back into the atmosphere, Carbon sink, Trapping carbon (including photosynthesis), Releasing carbon (including respiration)
- What are some human impacts on the carbon cycle?

E. Biogeochemical Cycle: CARBON

E. Biogeochemical Cycle: NITROGEN

Diagram on Blank Slide Should Include- FNAAD → ANPAN

- What are the impacts of excess nitrogen in water and in the air?
- What are some human impact on the nitrogen cycle?

E. Biogeochemical Cycle: NITROGEN

E. Biogeochemical Cycle: NITROGEN

Process	Products	Description
F	A	
N	N	
A	P	
A	A	
D	N	

E. Biogeochemical Cycle: PHOSPHOROUS

E. Biogeochemical Cycle: SULFUR

- ONLY cycle _____
- What are the major reservoirs of phosphorus?
- How does the absence/presence affect productivity in an ecosystem?
- What are some human impacts on the phosphorous cycle?

- What are the major reservoirs of sulfur?
- Major impacts of sulfur on the environment?
- What are some human impacts on the sulfur cycle?

III. Population

- **A. Population Biology Concepts**

Population ecology; carrying capacity; reproductive strategies; survivorship

- **B. Human Population**

- **1. Human population dynamics**

Historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams

- **2. Population size**

Strategies for sustainability; case studies; national policies

- **3. Impacts of population growth**

Hunger; disease; economic effects; resource use; habitat destruction

A. Population Biology Concepts

- **Biotic Potential**

- **Logistic vs Exponential Growth**



A. Population Biology Concepts

- **What is carrying capacity (K) and what factors affect it?**

- **Malthusian Growth?**

- **Boom/Bust Cycles- Overshoot & Dieback**

A. POPULATION GROWTH

- **Reproductive strategies**

<u>K- adapted</u>	<u>r-adapted</u>

A. POPULATION GROWTH

- **Factors regulate population growth**

- **Measures of Birth Rate:**

- **Natality**
 - **Fecundity**
 - **Fertility**

- **Immigration**

- **Emigration**

- **Measures Longevity:**

- **Mortality**
 - **Survivorship**

A. POPULATION GROWTH

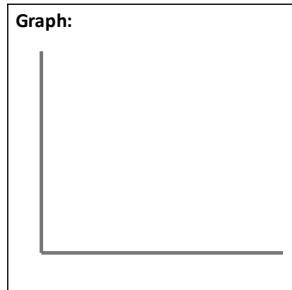
- **Survivorship Curves-**

- **Type 1:**

- **Type 2:**

- **Type 3:**

- **Why won't all organisms fall into these 3 categories?**



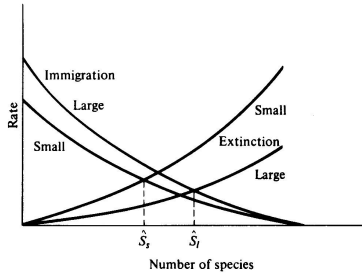
A. POPULATION GROWTH

• Factors that regulate population growth:

- Abiotic Factors
- Biotic Factors
- Density Dependent Factors
- Density Independent Factors

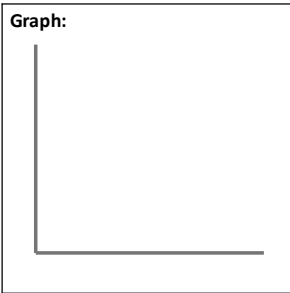
A. POPULATION GROWTH

• Explain the Theory of Island Biogeography:



B. HUMAN POPULATION

• Historical Population Growth



Description of Growth & Reasoning:

• Human Demography

World population = _____

US Population = _____

B. HUMAN POPULATION

DEVELOPED	DEVELOPING

B. HUMAN POPULATION

URBAN	RURAL

B. HUMAN POPULATION

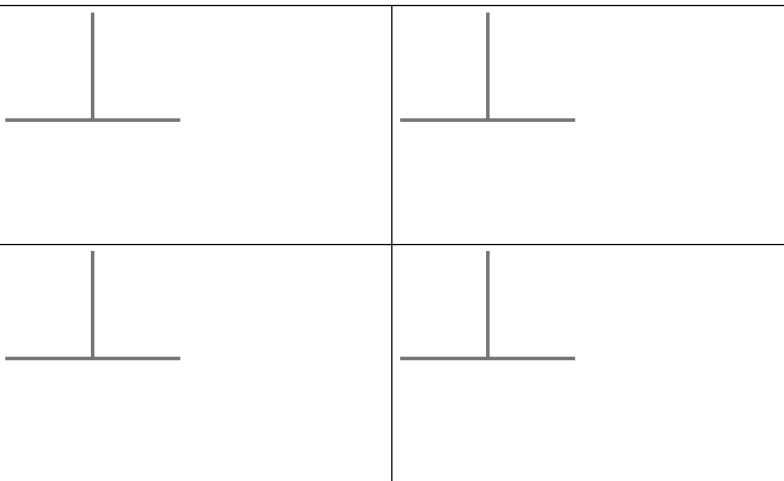
- Population Momentum
- Replacement Fertility
- Zero Population Growth

B. HUMAN POPULATION

- How do you calculate doubling time?
- How do you calculate growth rate (r)?
- How do you calculate Crude Birth/Death Rate?

B. HUMAN POPULATION

Age Structure Diagrams – Draw, identify and describe the 4 major types



B. HUMAN POPULATION

- Impacts of population growth
 - Hunger/Disease
 - Economic Effects
 - Resource Use/Habitat Destruction

B. HUMAN POPULATION

- Demographic Transition- Graph & explain 5 stages

B. HUMAN POPULATION

- Population size
 - Strategies for Sustainability
 - Case Studies/National Policies
 - China
 - India

IV. Land and Water Use

- A. Agriculture
 - 1. Feeding a growing population

Human nutritional requirements; types of agriculture; Green Revolution; genetic engineering and crop production; deforestation; irrigation; sustainable agriculture
 - 2. Controlling pests

Types of pesticides; costs and benefits of pesticide use; integrated pest management; relevant laws
- B. Forestry

Tree plantations; old growth forests; forest fires; forest management; national forests
- C. Rangelands

Overgrazing; deforestation; desertification; rangeland management; federal rangelands

IV. Land and Water Use

D. Other Land Use

1. Urban land development

Planned development; suburban sprawl; urbanization

2. Transportation infrastructure

Federal highway system; canals and channels; roadless areas; ecosystem impacts

3. Public and federal lands

Management; wilderness areas; national parks; wildlife refuges; forests; wetlands

4. Land conservation options

Preservation; remediation; mitigation; restoration

5. Sustainable land-use strategies

E. Mining

Mineral formation; extraction; global reserves; relevant laws and treaties

F. Fishing

Fishing techniques; overfishing; aquaculture; relevant laws and treaties

G. Global Economics

Globalization; World Bank; Tragedy of the Commons; relevant laws & treaties

A. Food & Agriculture

Types of agriculture-

- Alley cropping
- Crop rotation
- Intercropping
- Low-till/No-till
- Monoculture
- Polyculture
- Subsistence agriculture

A. Food & Agriculture

Fertilizers

- Organic vs. Inorganic Fertilizers
- Common forms
- Advantages & Disadvantages

A. Food & Agriculture

Human Nutritional Requirements

- Macronutrients:
- Micronutrients:
- Macromolecules:

Undernutrition vs Malnutrition vs Overnutrition

Kwashiorkor & Marasmus

A. Food & Agriculture

First Green Revolution

Second Green Revolution

Genetic engineering (GMOs) → Pros vs Cons

A. Pest Control

What is a pest?

Pesticide Treadmill:

D. Other Land Use

- Transportation Infrastructure
 - Federal Highway System
 - Canals and Channels
 - Roadless Rule - Roadless Areas & Ecosystem Impacts

D. Other Land Use

- Land conservation options
 - Preservation
 - Remediation
 - Mitigation
 - Restoration

E. Mining

- Methods of Extraction
 - Surface Mining
 - Underground Mining
 - In Situ Leaching

D. Other Land Use

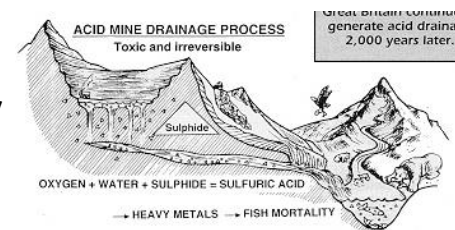
- Public and Federal Lands
 - Wilderness Areas
 - National Parks
 - National Forests
 - Wildlife Refuges
 - What organizations manages public & federal lands?

E. Mining

- Four Major Steps of Mining
 - Site Development
 - Extraction
 - Processing
 - Reclamation

E. Mining

- Acid Mine Draining / Acid Rock Drainage



- Include Formulas:

E. Mining

- Location & Estimated Supply

Global reserves -

- Oil reserves
- Coal reserves
- Natural gas reserves
- Global mineral reserves

Relevant Laws and Treaties

F. Fishing

- **Fishing techniques-**

- Bottom Trawling
- Drift Net
- Long Line
- Purse Seine

- **Bycatch –**

F. Fishing

- **Overfishing- Remediation Techniques**

- **Aquaculture- Pros vs. Cons**

- **Relevant Laws and Treaties**

G. Global Economics

- Describe & explain the significance of each-

- Globalization
- World Bank
- International Monetary Fund
- World Trade Organization

G. Global Economics

- **Tragedy of the Commons – Summary & Examples**

V. Energy Resources & Consumption

- A. Energy Concepts

Energy forms; power; units; conversions; Laws of Thermodynamics

- B. Energy Consumption

1. History

Industrial Revolution; exponential growth; energy crisis)

2. Present global energy use

3. Future energy needs

- C. Fossil Fuel Resources and Use

Formation of coal, oil, and natural gas; extraction/purification methods; world reserves and global demand; synfuels; environmental advantages/disadvantages of sources)

V. Energy Resources & Consumption

- **D. Nuclear Energy**
Nuclear fission process; nuclear fuel; electricity production; nuclear reactor types; environmental advantages/disadvantages; safety issues; radiation and human health; radioactive wastes; nuclear fusion
- **E. Hydroelectric Power**
Dams; flood control; salmon; silting; other impacts
- **F. Energy Conservation**
Energy efficiency; CAFE standards; hybrid electric vehicles; mass transit
- **G. Renewable Energy**
Solar energy; solar electricity; hydrogen fuel cells; biomass; wind energy; small-scale hydroelectric; ocean waves and tidal energy; geothermal; environmental advantages/disadvantages

A. ENERGY CONCEPTS

- **Potential vs. Kinetic Energy**

- **Give an example of each energy form:**
 - Mechanical -
 - Thermal -
 - Chemical -
 - Electrical -
 - Nuclear -
 - Electromagnetic -

B. ENERGY CONSUMPTION

- **Present U.S. & Global Energy Use**

- **Future Energy Needs**

A. ENERGY CONCEPTS

Laws of Thermodynamics

- **1st Law:**

- **2nd Law:**

- **Implications for living organisms:**

A. ENERGY CONCEPTS

- **Power-**

- **Units of Energy :**
 - BTU
 - Horsepower
 - Watt
 - Calorie

C. Fossil Fuel Resources & Use: COAL

- **Formation of Coal (Process & Hiltz Law)**

- **Extraction methods**

- **Environmental advantages/disadvantages**

- **World reserves and global demand**

C. Fossil Fuel Resources & Use: COAL

- **Methods to Reduce Pollutants from Coal**
 - Beneficiation
 - Baghouse Filters
 - Wet Scrubbers
 - Electrostatic Precipitators

C. Fossil Fuel Resources & Use: Natural Gas

- Formation of Natural Gas
- Extraction methods
- Environmental advantages/disadvantages
- World reserves and global demand

D. NUCLEAR ENERGY

- Describe each step of the Uranium Fuel Cycle
 1. Mining
 2. Milling
 3. Conversion
 4. Enrichment
 5. Fuel Fabrication
 6. Nuclear Reactor
 7. Spent Fuel Reprocessing

C. Fossil Fuel Resources & Use: OIL

- Formation of Oil
- Extraction methods
- Environmental advantages/disadvantages
- World reserves and global demand

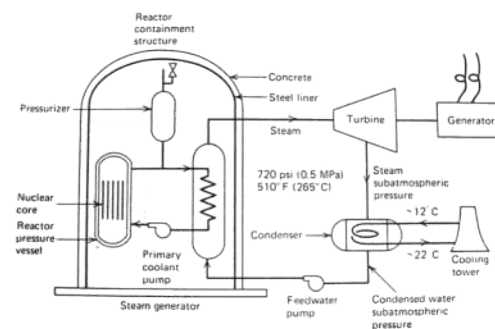
D. NUCLEAR ENERGY

- Nuclear Fission process
- Fertile vs Fissile
- Nuclear Fuel → U-235, U-238, Pu-239, & Pu-240

D. NUCLEAR ENERGY

- Describe the electricity production process:

- Waste products?



D. NUCLEAR ENERGY

- Environmental Advantages/Disadvantages

- Safety Issues

- Case Studies:

- Chernobyl

- Fukushima Daiichi

*** Other Nonrenewable Energy Sources**

- Methane Hydrates

- Oil Shale

- Oil Sands / Tar Sands

- Synfuels

E. HYDROELECTRIC POWER

- Flood Control Methods

- Channelization

- Dams

- Levees or Floodwalls

D. NUCLEAR ENERGY

- Fusion Process:

- Advantages & Disadvantage:

E. HYDROELECTRIC POWER

- Energy Generation Process

- Major Consumers?

- Advantages/Disadvantages to Dams

F. ENERGY CONSERVATION

- List 5 conservation methods-

- 1.

- 2.

- 3.

- 4.

- 5.

F. ENERGY CONSERVATION

- Smart Grids
- CAFÉ Standards
- Environmental Advantages of Mass Transit

G. RENEWABLE ENERGY

- Describe & Provide Advantages/Disadvantages
 - Biogas(Methane)
 - Biomass
 - Biofuel (Ethanol & Biodiesel)

G. RENEWABLE ENERGY

- Describe & Provide Advantages/Disadvantages
 - Geothermal
 - Wind
 - Hydrogen

G. RENEWABLE ENERGY

- Describe & Provide Advantages/Disadvantages
 - Passive Solar
 - Active Solar
 - Photovoltaic Cells

G. RENEWABLE ENERGY

- Describe & Provide Advantages/Disadvantages
 - Ocean Waves & Tidal Energy
 - Small-Scale Hydroelectric

VI. Pollution

• **A. Pollution Types**

1. Air pollution

Sources — primary and secondary; major air pollutants; measurement units; smog; acid deposition — causes and effects; heat islands and temperature inversions; indoor air pollution; remediation and reduction strategies; Clean Air Act and other relevant laws

2. Noise pollution

Sources; effects; control measures)

3. Water pollution

Types; sources, causes, and effects; cultural eutrophication; groundwater pollution; maintaining water quality; water purification; sewage treatment/septic systems; Clean Water Act and other relevant laws

VI. Pollution

4. Solid waste

Types; disposal; reduction

B. Impacts on the Environment and Human Health

1. Hazards to human health

Environmental risk analysis; acute and chronic effects; dose- response relationships; air pollutants; smoking & other risks

2. Hazardous chemicals in the environment

Types of hazardous waste; treatment/disposal of hazardous waste; cleanup of contaminated sites; biomagnification; relevant laws

C. Economic Impacts

Cost-benefit analysis; externalities; marginal costs; sustainability

A. POLLUTION TYPES: AIR

Primary Sources - Cause & Effects

• CO

• CO₂

• SO₂

• NO

• NO₂

A. POLLUTION TYPES: AIR

Primary Sources - Cause & Effects

• VOCs

• PM_x (PM₁₀)

• Lead (Pb)

• Mercury (Hg)

A. POLLUTION

Indicator Species –

– Songbirds

– Amphibians

– Lichens

– Aquatic Invertebrates

A. POLLUTION TYPES: AIR

• What is a criteria pollutant?

• What are the six criteria air pollutants recognized by the EPA?

A. POLLUTION TYPES: AIR

Secondary Sources - Cause & Effects

• SO₃

• H₂SO₄

• HNO₃

• PANs

• Tropospheric O₃

A. POLLUTION TYPES: AIR

- Industrial vs Photochemical Smog (Chemical Formation & Health Effects) -

A. POLLUTION TYPES: AIR

- Indoor air pollution: sources of contaminants
- Remediation and reduction strategies for indoor/outdoor air pollution

A. POLLUTION TYPES: AIR

- Air Pollution & Thermal Inversion:
- Acid Deposition (Dry & Wet):
- Clean Air Act:

A. POLLUTION TYPES: NOISE

- Sources & Effects:
- Relevant Laws:

A. POLLUTION TYPES: WATER

- Cultural Eutrophication
- Groundwater Pollution
- Urban Runoff

A. POLLUTION TYPES: WATER

- Desalinization & Purification of Water:
- Clean Water Act:

A. POLLUTION TYPES: WATER

- **Sewage Treatment**
 - Primary treatment

 - Secondary treatment

 - Tertiary treatment
- **Septic Tanks**

A. POLLUTION TYPES: SOLID WASTE

- **Types & Disposal**
 - Organic
 - Radioactive
 - Soiled
 - Toxic
 - Recyclable
- **Reduction**

A. POLLUTION TYPES: SOLID WASTE

- **Reduction Strategies** - Pros vs Cons
- **Land-disposal-** (sanitary landfills & open dumping)

- **Ocean dumping**

- **Recycling & Reuse**

- **Incineration**

A. POLLUTION TYPES: WATER

Water Quality Tests	
Test	Impact
Temperature	
pH	
Hardness	
Dissolved Oxygen	
Biological Oxygen Demand	
Fecal Coliform	
Turbidity	
Nitrate, Nitrite, & Phosphates	

A. POLLUTION TYPES: SOLID WASTE

- **Reduction Strategies** - Pros vs Cons
 - Composting

 - Remanufacturing

 - Detoxifying

 - Exporting

 - Anaerobic Digestion

A. POLLUTION TYPES: SOLID WASTE

- **Relevant Laws** :
 - RCRA

 - CERCLA

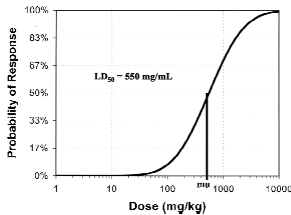
 - Case Study – Love Canal Housing Development

B. IMPACTS ON ENVIROMENT & HUMAN HEALTH

• Environmental Risk Analysis

• Acute vs. Chronic Effects

• Dose-response relationships- TD-50 vs LD-50



B. IMPACTS ON ENVIROMENT & HUMAN HEALTH

• Hazardous chemicals in the environment

- Mutagen
- Carcinogen
- Teratogen

B. IMPACTS ON ENVIROMENT & HUMAN HEALTH

• Persistent Organic Pollutants

• Relevant Treaties: Stockholm Convention

• Bioaccumulation vs. Biomagnification

B. IMPACTS ON ENVIROMENT & HUMAN HEALTH

• Hazardous chemicals in the environment

- Corrosive
- Ignitable
- Toxic
- Radioactive

B. IMPACTS ON ENVIROMENT & HUMAN HEALTH

• Brownfield/Brownsite –

• Cleanup of contaminated sites-

- Bioremediation
- Phytoremediation
- Incineration
- Surface Impoundments
- Deep Well Injection

B. IMPACTS ON ENVIROMENT & HUMAN HEALTH

• Case Study – Minamata, Japan

• Case Study – Endocrine Disruptors

B. IMPACTS ON ENVIROMENT & HUMAN HEALTH

- **Cost-Benefit Analysis**
- **Externalities:** Positive (external benefits) and Negative (external costs)
- **Marginal Costs**
- **Sustainability:** common threads, EPA

A. STRATOSPHERIC OZONE

- **Formation of stratospheric ozone**
- **Ultraviolet radiation-**
 - UVA
 - UVB
 - UVC

A. STRATOSPHERIC OZONE

- **Strategies for Reducing Ozone Depletion:**
- **Relevant laws and treaties: Montreal Protocol**

VII. Global Change

- **A. Stratospheric Ozone**
Formation of stratospheric ozone; ultraviolet radiation; causes of ozone depletion; effects of ozone depletion; strategies for reducing ozone depletion; relevant laws and treaties
- **B. Global Warming**
Greenhouse gases and the greenhouse effect; impacts and consequences of global warming; reducing climate change; relevant laws and treaties)
- **C. Loss of Biodiversity**
 1. Habitat loss; overuse; pollution; introduced species; endangered and extinct species
 2. Maintenance through conservation
 3. Relevant laws and treaties

A. STRATOSPHERIC OZONE

- **Cause & Effects of Ozone Depletion**

Include Equations:

B. GLOBAL WARMING

- **What is the Greenhouse Effect?**
- **Identify & Describe the Sources of the Major GHGs**

B. GLOBAL WARMING

- List Impacts & Consequences of Global Warming

- Case Study: Thawing Permafrost

B. GLOBAL WARMING

- Mitigating Factors for Climate Change

- Relevant laws and treaties

C. LOSS OF BIODIVERSITY

- Identify the factor and describe how it is harming biodiversity
1. H
 2. I
 3. P
 4. P
 5. C
 6. O

C. LOSS OF BIODIVERSITY

- Define & Provide examples
 - Endemic Species –

 - Threatened Species –

 - Endangered Species –

C. LOSS OF BIODIVERSITY

- What is the extinction vortex?

- What methods can be used to escape this?

C. LOSS OF BIODIVERSITY

- What is a biodiversity hotspot?

- Identify & Describe the Major Methods to Maintain Biodiversity

C. LOSS OF BIODIVERSITY

- Introduced Species/Invasive Species: definition, types, consequences, examples

ADDITIONAL: Key People in APES

- Garrett Hardin –
- Aldo Leopold –
- John Muir –
- Rachel Carson –

ADDITIONAL: Key Organizations in APES

- OPEC –
- EPA –
- IWC –
- IUCN –

C. LOSS OF BIODIVERSITY

Relevant Laws and Treaties:

- CITES
- Endangered Species Act

ADDITIONAL: Key People in APES

- Rowland & Molina –
- Wangari Maathai –
- Thomas Malthus –
- Theodore Roosevelt –

ADDITIONAL: Key Organizations in APES

- UN IPCC –
- WWF –
- NRDC –
- Sierra Club –