

- 1  **Introduction to Environmental Geology, 5e**
Chapter 1
Philosophy and Fundamental Concepts
- 2  **Intro to Geology: summary haiku**
Here's geology.
It's the study of the Earth -
complete entity.
- 3  **Case History: Island of Hispaniola**
 - Good site for comparative study: Dominican Republic versus Haiti
 - Biophysical differences: Rainfall, topography, land use/land cover
 - Socioeconomic differences: History, population, economic activities, GDP output
 - Reasons for degradation of Haiti's environment and subsequent inability to quickly rebuild after the 2010 large earthquake
- 4  **Table 1.1**
- 5  **Earth's Place in Space**
 - Earth: Geospatially isolated in the universe
 - Origin of the universe
 - Origin of Earth system: Lithosphere, atmosphere, hydrosphere, and biosphere
 - Facing limited resources: Energy, soil, freshwater, forests, ocean fisheries, rangelands
 - Global environment: Conflicts and integrated resolutions
- 6  **Earth History**
 - Inception: 4.6 billion yrs
- 7  **Earth Environment (1)**
 - James Hutton (1785): Earth as a superorganism
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 - James Lovelock: Gaia hypothesis
 - Earth is an organism
 - Life significantly affects Earth's environment
 - Life modifies the environment for the betterment of life
 - Life deliberately or consciously controls the global environment
 - Interdisciplinary thinking
- 8  **Earth Environment (2)**
 - Earth: Dynamic, alive, and complex
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 - Everything alive: With a beginning and an end
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 - Earth environment as a total, as a whole
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 - Prolong Earth's sustainable healthy life
 - Environment monitoring
 - Environment problems—mapping and analysis
 - Environment problem prevention and protection
- 9  **Environmental Sciences**
 - Environment: A complex system with physical, biological, geological, ecological, and geopolitical aspects.
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 - Requires multidisciplinary research: Environmental geology, environmental chemistry, global climate change, biological diversity and ecosystems, environmental economics, environmental ethics, environmental law, etc.

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- Environmental crisis: Population, environmental hazards, resource limitations and contaminations, environment ownership (both in space and over time)
- 10  **Environmental Geology**
 - Environmental geology: Applied geology
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 - Environmental geology knowledge:
 - To better understand environmental problems
 - Geologic knowledge for problem solving
 - Minimize environmental degradation
 - Optimize the use of resources to maximize environmental benefits for the society
- 11  **Environmental Geology (cont.)**
 - Earth: Source for habitats and resources, waste disposal, environment and health issues
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 - Better understand the natural hazards
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 - Land and water resources: Use, planning, and management
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 - Geologic aspect in every environmental condition
- 12  **Fundamental Concepts**
 - Five fundamental concepts
 - Population growth
 - Sustainability
 - System and change
 - Hazardous Earth processes
 - Scientific knowledge and values
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 - Other important concepts in environmental geology
 - Finite resources, obligation to future
- 13  **Human Population Growth (1)**
 - Number one environmental problem: Nearly 7 billion by the year 2010
 - “Population bomb?” Exponential growth
 - Exponential growth
 - Growth rate (G): Measured as a percentage
 - Doubling time (D): $D = 70/G$
 - Above Earth’s comfortable carrying capacity: Use more resources, need more land space, generate more waste
 - Earth as the only suitable habitat in the foreseeable future
- 14  **Human Population Growth (2)**
 - Population Bomb: About to Explode?
- 15  **Human Population Growth (3)**
 - Compares four countries
- 16  **Human Population Growth (3)**
- 17  **Human Population Growth (4)**
 - Uneven growing pace and distribution
 - By 2050, 3 billions more people
 - Almost all of the growth in developing countries
 - No easy answer to the population problems
 - Education is paramount, especially woman’s education. As people become more educated, the population growth rate tends to decrease
 - Good news: The rate of population growth is decreasing
- 18  **Sustainability (1)**

Sustainability: The environmental objective

- An evolving concept
- Expectation and reality
- Criteria variations in space and over time
- Is a long-term concept and has long-term implications
- Requiring careful resources allocation, large-scale development of new technology for resource use, recycling, and waste disposal

19  **Sustainability (2)**

Measuring sustainability

- Use and consumption of non-renewable resources
- Natural replenishment and renewable rates
- Global consumption versus replenishment of resources
- Development and improvement of human environment versus viable environment
- Not lead to environmental crisis

20  **Sustainability: The Death of Aral Sea (3)**

- Once a prosperous vacation spot in 1960
- Water diversion for agriculture
- Dying sea surrounded by salt flats
- Largely irreversible

21  **Earth's Systems and Changes (1)**

- System conditions: Open versus closed systems
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- System input-output analysis
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- System changes: Types of changes, rates of changes, scales of changes, etc.
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- Rates of change: Average residence time
 - $T = S/F$
 (T: residence time, S: total size of stock, F: average rate of transfer)

22  **Earth's Systems and Changes (2)**

- Earth: A dynamic system
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- Four interconnected subsystems: Lithosphere, atmosphere, hydrosphere, and biosphere
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- Four subsystems are interconnected and interdependent
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- Present human activity key to understanding the future

23  **Predicting Future Changes**

- Uniformitarianism
 - The present is the key to the past
 - The present is the key to the future
 - Changes of frequency and magnitude: Geological processes and human activities
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- Environmental unity: Chain of actions and reactions
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- Earth system
 - Gaia hypothesis: Earth is a living organism
 - Complex and interrelated subsystems
 - Global perspective on environment

24  **Hazardous Earth Processes**

Hazardous Earth processes and risk statistics for the past two decades

- Annual loss of life: About 150,000
- Financial loss: > \$20 billion
- Millions of life loss during the past 20 years, particularly catastrophic from a major natural disaster in a developing country (2003 Iran quake, ~30,000 people, 2004 Asia tsunamis, ~300,000)
- More property damage occurs in a more developed country

25 **Scientific Knowledge and Values (2)**

- 3-D environmental problems
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- Changes of environment in the 4-D (time)
 - Expansiveness of geologic time
 - Broad spectrum of geologic processes
 - Great variations in rates of geologic processes
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- Scientific methods for complex environmental problems

26 **Science and Solution**

- Science: Accumulated knowledge
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- Knowledge: Basis for decision making
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- Scientific methods: Formulate possible solutions to environmental problems
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- Scientific design: Structure more suitable for certain environmental settings
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- Scientific info: Public awareness and environmental regulations

27 **Scientific Knowledge and Values (1)**

28 **Scientific Knowledge and Values (1)**

29 **Closer Look: Knowledge, Imagination, and Critical Thinking**

- Knowledge: What is known
- Imagination: No limits, leading to out-of-the-box thinking of the unknown
- Scientific investigation: Needs critical thinking
- Critical thinking: Significance, logic flow, relevance, breadth and depth, clarity, fair test
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30 **Geological Time Dimension**

- The important variable that distinguishes geology from other sciences
- Varied rate of geological processes: mm/yr to km/s
- Humans are a super agent of change
 - Holocene epoch
 - Industrialization and global environmental changes
- Culture and environmental awareness: Land ethic
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31 **Solving Environmental Problems**

- Difficult processes
- Environmental problems tend to be complex
- Rapid changes, slow recognition, slower actions
- Some changes are of irreversible nature
- Environmental policy links to environmental economics in infancy
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32 **Precautionary Principle**

- Scientific certainty not required to take a precautionary approach
- Scientific proof not possible in dealing with many environmental problems
- Maybe difficult to apply
- Lead to a proactive approach with an emphasis on environmental unity
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33  **Applied and Critical Thinking Topics**

- Do you think the Earth is a living organism? Why or why not?
- Why are people in Haiti so vulnerable to major natural hazards?
- Why did you take this environmental geology course?
- Would an exponential negative growth of human population be a solution to many environmental problems?
- Are there any conflicts between global environmental unity principle and regional economic development?

34  **End of Introduction to Environmental Geology**