



Chapter 1: Introduction

A Scientific Approach to Geography

Chapter Objectives

- 1. What is a scientific approach to geography?**
- 2. How is science both an individual and a social activity?**
- 3. What are several metaphysical beliefs characteristically held by scientists?**
- 4. What are four goals of scientific activity?**
- 5. What are the relationships of natural science, social science, and the humanities to the study of geography?**





So, what even is science?

The Logic and Philosophy of Science

Science is a personal and human endeavor in which ideas and empirical evidence are logically applied to create and evaluate knowledge about reality

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Science is a human activity where people use ideas and evidence to understand and learn about the world.



“Science is a personal and human endeavor”

- First and foremost, science is done for humans, by humans
 - We learn science from other human scientists
 - We do science with other human scientists
 - We present our findings to other humans
 - We may improve human lives or expand human knowledge



“in which ideas and empirical evidence ”

- Similar to how operations drive intelligence (in a recursive way), ideas drive science
 - Ideas lead to studies (units of focused observation or data collection)
 - Studies lead to empirical evidence
 - Empirical evidence leads to new knowledge
 - New knowledge leads to new ideas, ad infinitum
- About that word “empirical”
 - Derived from systematic observation of the world via the senses
 - Often aided by technology
 - Aims to be repeatable, accumulable, and publicly observable
 - Varies science from: intuition, authority, anecdote, etc.



“are logically applied to create and evaluate knowledge about reality”

- Ideas and evidence should be applied to certain principles. A few are:
 1. One must avoid contradictions
 - If contradictions are present, problems are present
 - If Person 1 says $A + B = C$, and Person 2 says $A + B = D$, there is a contradiction
 2. Confidence in phenomenon increases with increased observation
 - If Person 1 gets $A + B = C$ many times, confidence increases
 3. Past regularities will likely occur in the future
 - If Person 1 gets $A + B = C$ in a year, and Person 2 gets $A + B = C$ another year, the experiment is shown to be repeatable





A Note on Logic

- **There is not just 1 certified way of thinking doing science**
 - **Deductive Reasoning:** If the premises are true, the conclusion must also be true.
 - Start with theory then test it. General -> Specific
 - **Inductive Reasoning:** Conclusions are probable and based on patterns in observations, but new evidence could change them.
 - Start with an observation, build a theory. Specific -> General
 - **Abductive Reasoning:** Finding the best possible explanation for the data at hand.
 - Start with observations, infer the best explanation
- **There are also times logical thinking cant win the day**
 - Creative thinking on ideas
 - Areas of science that are “theoretical”



A Note on Logic

- **Deductive Reasoning:** General -> Specific
 - All men are mortal
 - Socrates is a man
 - Socrates is mortal
- **Inductive Reasoning:** Specific -> General
 - Socrates is a man and he is mortal
 - Other men are also mortal
 - All men are mortal
- **Abductive Reasoning:** Best Possible Explanation
 - Socrates is mortal
 - All men are mortal
 - Socrates must be a man



A Note on Nonscientific Ways of Knowing

- **The humanities are similar to science in logical application of ideas to understand the world, but often do not use systemic empirical observation.**
 - Scientists may want simple truth, while the humanities searches for specific truths about peoples/societies or for human values/morality. As a rule: Numbers are clean, people are messy.
 - Artists search for general knowledge about a given craft, but usually do not employ systemic empirical methodologies. Usually are concerned with production of items, rather than simply knowing.
 - Spiritual approaches to knowing usually do not employ empiricism, do not accept Realist philosophy, or employ skepticism as a matter of doctrine (depending)
 - Paranormal approaches to knowing tend to not employ systemic empiricism, but may be uncritical if empirical evidence is presented. Additionally, certain paranormal activity may violate forward causality

Goals of Science

Since the definition of science is to understand and learn about the world, there are four goals set to accomplish that:

1. Description: to distinguish and describe phenomena
2. Prediction: to understand the patterns in phenomena and predict when phenomena occurs
3. Explanation: to explain *why* phenomena happens
4. Control: to be able to bring desired change to phenomena

At that note, there are 2 different types of scientific research: Basic and Applied science

- Basic science sets to accomplish understanding the world for its own sake
 - Focus on description, prediction, and explanation
- Applied science sets to solve problems or meet needs
 - Focus on control, but requires a basis of the other 3 goals





What makes a scientist?

Characteristic Metaphysical Beliefs of Scientists

- What is metaphysics?
 - An idea, doctrine, or posited reality outside of human perception
- What is a “metaphysical belief”?
 - Intellectual preferences
 - Unproven
 - For scientists, not necessarily all required, but usually common traits



Characteristic Metaphysical Beliefs of Scientists

1. Realist Philosophy

- The universe is an objective entity that has matter and energy patterned in space and time.
 - Simply put, nature will do its own thing, regardless of how we feel

2. Only continuous and forward causality

- Everything in space and time has a cause and effect
 - No gaps or reversals. Sorry time travelers

3. Simplicity

- The simplest explanation is the most correct, given adequate evidence (aka parsimony)
 - Differs from picking the most simple answer just because its simple

4. Skepticism

- Approach truth finding with the expectation of never finding the full truth
 - Preference for ideas that *could* be potentially proven false

5. Quantitative Thinking

- Use mathematics and computation to increase precision of ideas and observations (often aided by tech)





So where does Geography fit in with Science?

Geography: The First of the Sciences

- **The study of Earth as the home of humanity**
 - From Greek, literally “earth writing”
 - Broad range of topics, multi-discipline
 - If its on the surface of the Earth (or slightly below it), congrats, its (probably) geography
 - Or at least has a geographic component to it
- **Ancient Geography**
 - Historical geographers had three main goals:
 1. Economic
 - Natural resource extraction, trade routes
 2. Political
 - Civilization building, power consolidation, taxation, diplomacy
 3. Military
 - Geographic advantage, logistics, information warfare
 - Early geographers employed the use of linguistics (study of language), graphic (e.g. cartography), and mathematical (e.g. geodesy – measuring the earth) approaches to accomplish these study goals



Growing Pains

- **Sometime in the 19th Century, a new approach was developed: Regional Geography**
 - The world was divided into regions, and all natural (geomorphological, climatological) and human (cultural, economic) phenomena were characterized and organized into regional features.
 - Sometimes called the “National Geographic” approach
 - May be described as more qualitative
- **Later in the 19th century, a sibling approach flowered: Systematic Geography**
 - Elected to view the world through systems, choosing not just to describe the where, but understand how they work across the planet
 - E.g. River systems, Urban structures
 - Championed as more scientific, with a penchant for applying math
 - Development lead to the “quantitative revolution” by the 20th century, with using certain methods the “right way” to do geography:
 - Statistics, geometry, calculus, computers, remote sensing, GIS
 - Positivism was the new philosophy for Geography
 - A theory that everything can be explained through observation and empirical evidence

Growing Pains

- **From there, a counter-revolution emerged, pushing back against total positivism**
 - Assertion was data and numbers oversimplified the human experience
 - Left out a key component: humans are messy
 - Opted for inclusion of subjective thinking and using social theory in analysis to explain phenomena:
 - Phenomenology: Focuses on people's subjective experiences of space and place
 - Marxism: Analyzes geography through the lens of economic and social inequality, focus on capitalism
 - Feminism: Examines how gender influences spatial dynamics
 - Social Theory: Investigates the social structures and power relationships that shape geographic spaces
 - Deconstructionism: Challenges idea that representations are neutral entities
 - Postmodernism: Understanding that there is no 1 objective reality



Modern Geography: Reunification

- **Like the Earth, the growth of geography has come full oblate spheroid**
- Geographers have managed to mitigate differences in approach by combining approaches, and separated 2 main sections in Geography:
 - Physical and Human
 - Both use blends of linguistic, cartographic, and mathematical methods
- There is also the understanding that between both sections, geography is both:
 1. Multidisciplinary
 - Varied disciplines work side by side
 2. Interdisciplinary
 - Disciplines are combined
- E.G. Physical geography intersects with:
 - geology, biology, climatology
- Human Geography intersects with:
 - sociology, economics, anthropology, political science





**Questions?
Comments?
Concerns?**

Review Questions

1. What are the four scientific goals of description, prediction, explanation, and control, and how do they relate to each other?
 - Description is used to distinguish and describe phenomena. Description helps to categorize phenomena.
 - Prediction is used recognize patterns and predict phenomena based off those patterns.
 - Explanation is used to describe *why* phenomena happens. Explanations can assist in adding precision to prediction and/or description.
 - Control: Control is used to bring a desired change to phenomena. The three former goals assist in defining *how* to elicit change to phenomena.

Review Questions

2. What are the following "characteristic metaphysical beliefs" held by scientists: realism, continuously connected and forward causality, simplicity, skepticism, quantitative thinking?

- Realism posits the universe is an objective entity that does what it wants
- Forward Causality posits everything in space and time has cause and effect.
- Simplicity posits the simplest answer is usually the most correct (given proper evidence)
- Skepticism posits one should question true validity of all things
- Quantitative thinking posits math increases precision of ideas and observations