

NATURAL SCIENCES



Introduction



Natural sciences reflect a concerted effort on the part of humans to search for understanding of the world.

They are recognized as a model for knowledge owing to many factors, prime among which is their capacity to explain and make precise predictions.

The influence of the natural sciences permeates much of modern life, for example, the widespread and growing use of technologies.

How does this influence affect our understanding of and requirements for knowing and knowledge in all areas?

Nature of Sciences

- Which subjects does the term “natural sciences” include or exclude?
- Are there any grey areas?
- Do these areas change from one era to another, from one culture or tradition to another?
- Explain

Nature of (cont.)

- Should the natural sciences be regarded more as a method or more as a system of knowledge?
- How does this relate to what Poincare meant when he said, “Science is built of facts the way a house is built of bricks: but an accumulation of facts is no more science than a pile of bricks is a house”?
- To what extent do the answers to these questions vary among the natural sciences?

Nature of (cont.)

- Do the natural sciences make any assumptions that are unprovable by science (for example, that everything that happens is caused, that all causes are physical)?
- If so, what does this imply about natural sciences as an area of knowledge?

Natural Sciences: Methods of gaining knowledge

- What is meant by the “scientific method”?
- Is there a single scientific method, used in all the natural sciences and distinct from the methods of the other areas of knowledge?
- To what extent does the scientific method vary in different cultures and eras?

Methods (cont.)

- To what extent do methods vary within the natural sciences?
- What effects might such variation have? For example, have you experienced methodological disputes or confusions in your own work in experimental science?
- What are the roles of various kinds of reasoning in science?

Methods (cont.)

- To what extent do scientists rely on either confirming or falsifying a hypothesis?
- Is either matter ever straightforward?
- What does this tell us about the nature of the scientific endeavor?

Methods (cont.)

- What are the implications of the following claim for the aspirations of natural sciences in particular and for knowledge in general?
 - “One aim of physical sciences has been to give an exact picture of the material world. One achievement of physics in the twentieth century has been to prove that this aim is unattainable.”
 - Jacob Bronowski

Methods (cont.)

- In the Diploma Program Group 4 subjects are designated “experimental sciences”. What counts as an experiment?
- Can experiments be undertaken in other subjects?
- Are there some necessary conditions for an activity to be an experiment, for example, hypotheses, data, manipulation of variables, observations, generalizations and expectations of outcomes?

Methods (cont.)

- What are the similarities and differences in methods used in the natural sciences in comparison with those used in the human sciences?
- To what extent do their fields of study overlap?
- To what extent would it be true to say that the human sciences appear less scientific because their subject matter is more complex?
- What difference does it make if instead of studying atoms or plants, we are studying creatures who can think and act?

Methods (cont.)

- What is the role of imagination and creativity in the sciences?
- To what extent might the formulation of a hypothesis or invention of a research method be comparable to imagining and creating a work of art?

Methods (cont.)

- What knowledge, if any, will always remain beyond the capabilities of science to investigate or verify?
- If there is, or can be such knowledge, why will it always elude effective scientific treatment?

Natural Sciences and Knowledge Claims

- What kinds of explanations do scientists offer, and how do these explanations compare with those offered in other areas of knowledge?
- What are the differences between theories and myths as forms of explanation?

Knowledge claims (cont.)

- To what extent can all the natural sciences be understood through the study of just one science, for example, physics?
- If biology relies on chemistry, and chemistry relies on physics, can it be said that all natural sciences are reducible to physics?
- If so, what would be the implications of this position?

Knowledge claims (cont.)

- Is scientific knowledge progressive?
- Has scientific knowledge always grown?
- In this respect, how do the natural sciences compare with other areas of knowledge, for example, history, the human sciences, ethics and the arts?
- Could there ever be an “end” to science? In other words, could we reach a point where everything important in a scientific sense is known?
- If so, what might be consequences of this?

Knowledge claims (cont.)

- Is it accurate to say that much of science investigates entities and concepts beyond everyday experience of the world, such as the nature and behavior of electromagnetic fields, subatomic particles, or the space—time continuum?
- Do the entities in scientists' explanatory models and theories (for example, Higgs bosons, selfish genes) actually exist, or are they primarily useful inventions for predicting and controlling the natural world?
- What consequences might questions about the reality of these entities have for the public perception and understanding of the science?
- But if they are only fictions how is it that they can yield such accurate predictions in many cases?

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Knowledge claims (cont.)

- How different are the knowledge claims of those disciplines that are primarily historical, such as evolutionary biology, cosmology, geology and paleontology, from those that are primarily experimental, such as physics and chemistry?

Natural Sciences and Values

- How does the social context of scientific work affect the methods and findings of science?
- Is science, or ought it to be, value-free?
- What implications does your answer have for the regulation of science? For example: who should decide whether particular directions in research are pursued?
- Who should determine priorities in the funding of research?

Values (cont.)

- Should scientists be held morally responsible for the applications of their discoveries?
- Is there any area of scientific knowledge the pursuit of which is morally unacceptable or morally required?

Values (cont.)

- It has been argued that certain discoveries (such as quantum mechanics, chaos theory, Heisenberg's uncertainty principle, Einstein's theory of relativity, Darwin's theory of evolution) have had major implications for knowledge outside their immediate field.
- Why is it that science has the power to inform thinking in other areas of knowledge such as philosophy and religion?
- To what extent should philosophy and religion take careful note of scientific developments?

Natural sciences and technology



- Is scientific knowledge valued more for its own sake or for the technology that it makes possible?
- Is there any science that can be pursued without the use of technology?

Technology (cont.)

- There are some scientific fields that depend entirely upon technology for their existence, for example, spectroscopy, radio or x-ray astronomy.
- What are the knowledge implications of this?
- Could there be problems of knowledge that are unknown now, because the technology needed to reveal them does not exist yet?

Natural sciences: Metaphor and reality

- If natural sciences are defined as investigating the natural world, what is meant by “natural” or “nature” in this context?
- What difference might it make to scientific work if nature were to be regarded as a machine (for example, as a clockwork mechanism) or as an organism (such as in some interpretations of the Gaia Hypothesis)? How useful are these metaphors?

Metaphor and reality

- Does scientific language and vocabulary have primarily a descriptive or an interpretive function?
- Consider here expressions such as “artificial intelligence,” “electric current,” “natural selections” and “concentrations gradient.”