Scientific Reductionism

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Scientific reductionism is the idea of reducing complex interactions and entities to the sum of their constituent parts, in order to make them easier to study.

One form of scientific reductionism follows the belief that every single process in nature can be broken down into its constituent parts and can be described scientifically.

The broadest sense of the term upholds the idea that science can be used to explain everything, and that nothing is unknowable. By looking at the individual constituent processes, scientists can gain an understanding of the whole process.

For example, a reductionist believes that the complexity of the human brain is a result of complex and interacting physical processes. If scientists research and understand these underlying chemical reactions, then they can explain intelligence, emotion and all of the other human conditions.

The only way to comprehend fully the sheer complexity of the human brain is to look at the individual pieces.

The Limitations of Scientific Reductionism

Ecologists and biologists often use scientific reductionism, because trying to explain every

simple process needed for a scientific experiment is often difficult.

However, many opponents attack the process, believing that biological organisms are too complex to explain by numbers alone.

In humans, where emotions may be too difficult to assess empirically by physiology, scientific reductionism [1] stands accused of vast oversimplification. Social scientists may find that the sophisticated interactions behind the functioning of societies and populations are too unpredictable to describe by formulas or observations of individuals.

Even physicists are finding that the quest for fundamental particles making up matter and governing the laws of the universe may be much too difficult to study, without looking at the model as a whole.

Unlike Newtonian physics, modern research takes into account the complex interactions between the particles, rather than looking at them individually.

Chaotic systems, such as turbulence, weather patterns and even the behavior of crowds are difficult to explain by the process of scientific reductionism.

In addition, isolating one phenomenon and studying it often changes its behavior. For example, it is impossible to measure both the position and speed of an electron, because measuring one affects the other. Therefore, the very purest reductionist principles cannot be used to describe anything.

The common consensus seems to be that scientific reductionism is too flawed to act as a valid philosophical viewpoint. Aside from the problems involved in applying the idea to abstract ideas such as emotion and being, it is very impractical. Many areas, such as quantum physics, are too complicated to describe by studying the individual parts, and doing so does not always give the best picture.

Think about it this way: If you want to measure the efficiency of a car engine, is it better to break it all down and measure each component part individually, or just measure the efficiency of the engine as a whole. Whether the idea is valid or not becomes irrelevant, because it is an impractical undertaking.

Scientific Reductionism - Still a Useful Tool

In many other areas, the principle is sound. Modeling the weather or understanding genetics are well served by the principle, but it does have distinct boundaries where looking at the whole principle is much more accurate.

If a looser terminology is used, it can be argued that chemistry and biology are merely reductions of physics, allowing a fuller picture to be gleaned by looking at specific cases.

One area that uses reductionism extensively is computer modeling. For example, if a scientist designs a computer program to model and predict weather patterns, they cannot possibly include every single permutation of such a vast and complicated system. Instead, they simplify many of the elements to allow the program to work without losing the accuracy.

This is related to ‘Black Box’ science, where part of a system is regarded as a box. The scientist knows that any data inputted into the box results in a certain output, so they do not need to model every last process within the box.

Scientific reductionism is not a viable theory in modern science, because the processes governing the universe are so complex and intertwined that they can never be understood fully. Despite this, reductionist thinking does have some uses, and allows complex processes to be teased apart and understood.

Links
[1] http://en.wikipedia.org/wiki/Reductionism