

# Information

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Information matters for materialism, and consequently for physical life, because it is one of the crucial components comprising material existence and materiality. Cesar Hidalgo (2015) observes that “our world is pregnant with information. It is not an amorphous soup of atoms, but a neatly organized collection of structures, shapes, colors, and correlations. Such ordered structures are the manifestations of information, even when these chunks of physical order lack any meaning”.

Information is a fundamental feature of material existence because of its provision of pattern or organization of matter itself. Information is therefore imparted by all kinds of materialisms.

Marcia Bates (2006) discusses how information is, materially, all around us. She states that “all the patterns of organization of matter and energy — cognitive, physical, architectural, social, linguistic — are informative. Therefore, to fully understand [information and how we seek and use it] requires the identification of the roles of all these forms of information”. Or, as Seth Lloyd, as quoted by Lyn Robinson and David Bawden (2014), states, “life, language, human beings, society, culture – all owe their existence to the intrinsic ability of matter and energy to process information”.

Information is transversal because it cuts across all material boundaries. Bates illuminates this transversality by characterizing information as all-encompassing and evolutionary. She argues that living beings assign meaning to information, but patterns or orders of organization of matter and energy are not inherently meaningful in and of themselves. She illuminates this distinction by presenting two degrees of information: information 1 and 2.

The first degree is “information 1”, which is the pattern or order of organization of matter and energy. She describes how information exists throughout the universe, whether or not living beings or transient agents are ever aware of, perceive, or use it. The second degree is “information 2”, which is some pattern or order of organization of matter and energy that is given meaning by a living being or transient agent. She explains that living beings or transient agents must somehow be aware of, perceive,

use, and, in so doing, give some kind of meaning to information. In other words, information 1 is simply, but nevertheless importantly, information 1 until some actor interprets and gives meaning to it, thereby transforming it into information 2. Once information 2 has emerged, it may then be integrated with the rest of the actor's knowledge, which itself is information given meaning and integrated with other contents of its understanding, particularly in terms of its encoded, embodied, experienced, enacted, and expressed forms of information.

Information, in fact, needs physical mechanisms for its growth, spread, and presence in and throughout the universe. According to Hidalgo, these three physical mechanisms are: energy (for information to emerge), solids (for information to endure), and matter (for computation of some kind). The first physical mechanism is when energy helps catalyze, trigger, or spur on information's emergence. The second physical mechanism involves solids that help information endure. The third physical mechanism is the ability of matter to compute. Hidalgo shows that "if matter could not compute, there would be no life. Bacteria, plants, and you and I are all, technically, computers. Our cells are constantly processing information". He continues that, "as matter learns to compute, it becomes selective about the information it accumulates and the structures it replicates. Ultimately, it is the computational capacities of matter that allow information to experience explosive growth".

Information, further, helps make up material order and objects. Material order is the pattern of information. Or, again, as Bates argues, "information is the pattern of organization of matter and energy". The complexity of patterns, or the higher degrees of order, depend upon more information; put differently, the more complex patterns, or higher orders, are results of (and demonstrate how much) information is involved or are in them. Regardless of how much of it is involved, information designs and structures the physical patterns of organization of the material world, biological patterns of organization of organisms, cognitive patterns of organization of the mind, and constructed patterns of organization created, extracted, stored, and/or used by (living) actors and agents as and in diverse kinds of material objects.

Material objects, moreover, are embodiments of information. As Hidalgo explains, "information, when understood in its broad meaning as physical order, is what...[we produce]. It is the only thing we produce, whether we are biological cells or manufacturing plants. This is because information is not restricted to messages. It is

inherent in all the physical objects we produce: bicycles, buildings, streetlamps, blenders, hair dryers, shoes, chandeliers, harvesting machines, and underwear are all made of information. This is not because they are made of ideas but because they embody physical order”.

These constructed patterns or orders of organization of material objects are what Michael Buckland (1991) calls “information-as-thing”. Buckland notes that, in many cases, humans, especially in information-intensive environments, are concerned and deal with information-as-thing. He states that “the means provided, what is handled and operated upon, what is stored and retrieved, is physical information”. Information-as-thing applies and refers to all kinds of tangible objects, especially those objects that are considered and used as some kind of documentation.

Buckland argues that information-as-thing is central to many human activities and undertakings. Information systems, for example, are directly concerned with information in this sense: libraries collect and manage books and other information resources; computer-based information systems generate and handle digital data; museums deal with diverse kinds of objects; and records and information centres steward information in its myriad forms and formats. In other words, what is created, handled, organized, managed, provided, accessed, retrieved, stored, preserved, and otherwise used is directly some kind of material (whether physical or digital) information-as-thing. Buckland’s information-as-thing therefore approaches information as something physical that manifests in and exists, or is contained, within some kind of material object; put differently, information is the pattern or order of organization of information-as-things (material objects), whether documents, rocks, plants, bodies, organs, earth, etc.

**KEYWORDS:** information, matter, energy, information-as-thing, pattern, order, organization

**GENEALOGIES:** Marcia Bates, Michael Buckland, Cesar Hidalgo (and James Gleick, David Bawden, B.C. Brookes, Ian Cornelius, Luciano Floridi, Lai Ma, Karl Popper, Lyn Robinson, Claude Shannon, Warren Wiener)

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