

## **MICROBES**

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Single-celled microorganisms were the first forms of life to develop on Earth, approximately 3–4 billion years ago. Further evolution was slow, and for about 3 billion years in the Precambrian eon, all organisms were microscopic. For most of the life history on Earth the only forms of life were microorganisms. Bacteria, algae and fungi have been identified in amber that is 220 million years old, which shows that the morphology of microorganisms has changed little since the Triassic period. Microorganisms tend to have a relatively fast rate of evolution. Most microorganisms can reproduce rapidly, and bacteria are also able to freely exchange genes through conjugation, transformation and transduction, even between widely divergent species. This horizontal gene transfer, coupled with a high mutation rate and other means of genetic variation, allows microorganisms to swiftly evolve (via natural selection) to survive in new environments and respond to environmental stresses. This rapid evolution is important in medicine, as it has led to the recent development of "super-bugs", pathogenic bacteria that are resistant to modern antibiotics. The possibility that microorganisms exist was discussed for many centuries before their discovery in the 17th century. The existence of unseen microbiological life was postulated by Jainism. Paul Dundas notes that Mahavira asserted the existence of unseen microbiological creatures living in earth, water, air and fire. The Jain scriptures also describe nigodas, which are sub-microscopic creatures living in large clusters and having a very short life, which are said to pervade every part of the universe, even the tissues of plants and animals. The earliest known idea to indicate the possibility of diseases spreading by yet unseen organisms was that of the Roman scholar Marcus Terentius Varro in a 1st-century BC book titled *On Agriculture* in which he warns against locating a homestead near swamps.