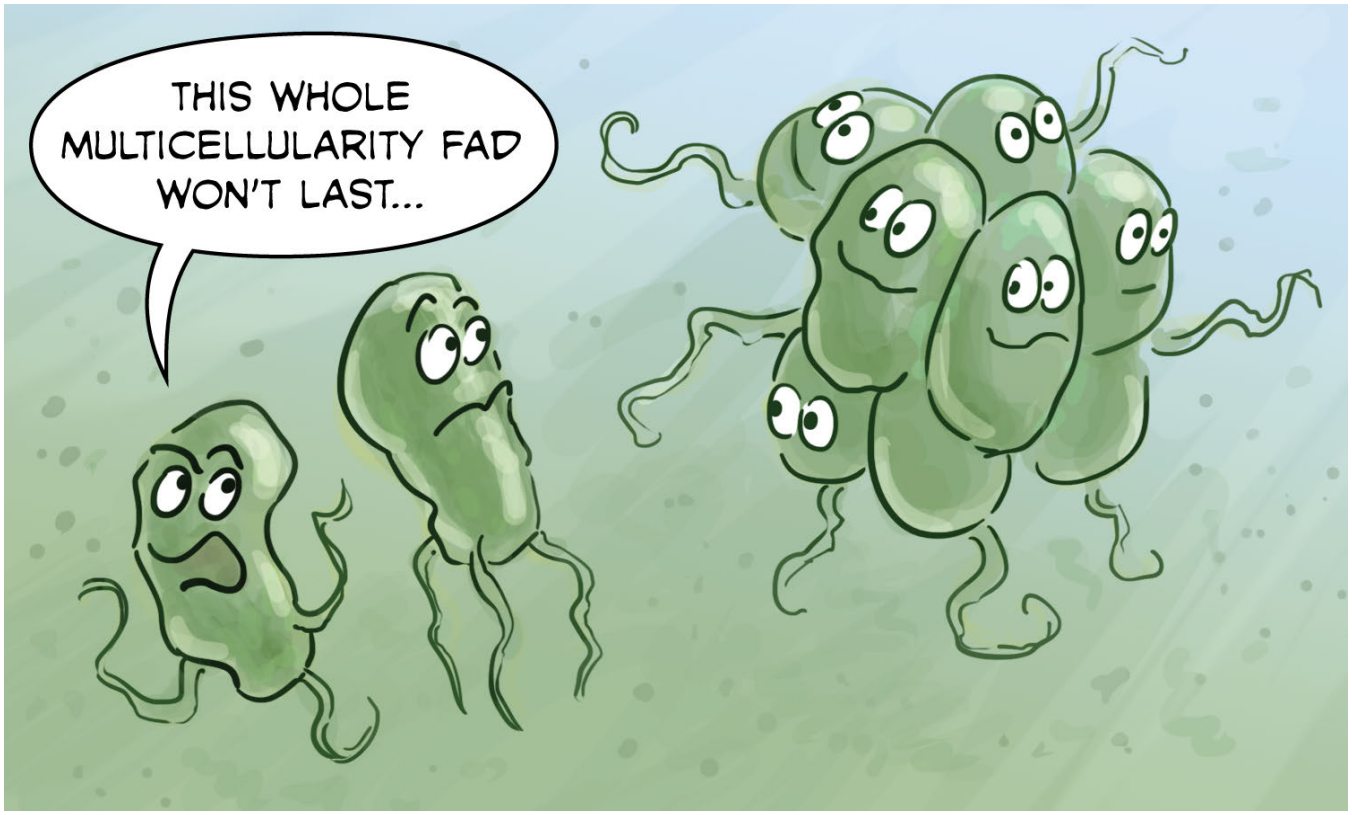
Teacher Tune-up

Quick Content Refresher for Busy Professionals

Why did some organisms evolve to be multicellular?



Unicellular organisms first appeared on Earth about 3.5 billion years ago, and they've proven to be remarkably successful at surviving and reproducing. They've been around for much longer than multicellular organisms, which didn't appear until about 600 million years ago, and they are much more abundant.

Unicellular organisms thrive in many different environments—including inside of us! One group of researchers recently suggested that a single human body carries an average of 39 trillion unicellular bacterial cells, easily outnumbering our human cells, which they put at around 30 trillion. Human cells are much larger than most bacteria, so even though we are internally outnumbered, so to speak, we are more human than bacterial by weight. The number of bacteria in a human body varies from person to person, and even changes with each visit to the bathroom. No matter the precise count, it's clear bacteria are successful and abundant organisms.

Given the success of unicellular organisms, how did multicellular organisms evolve? Multicellular organisms gain the benefits of cooperation. For example, when ecosystems change, multicellular organisms may be able to adapt more readily than a single cell, which is stuck in its rather limited environment. Multicellular animals more easily move, and multicellular plants grow leaves to seek out sunlight and roots to obtain water. When food runs out for a bacterial cell, it has few options; but when food runs out for a human, we can use our nervous system to learn about new options, our muscular and skeletal system to move us to new places, and even our supplies of fat to tide us over until we find our next meal. Cooperating cells can certainly make for a complex and flexible organism.

The big question for many scientists is what might convince cells to help one another in the first place. Experiments have shown that groups of cells that secrete and share useful molecules grow faster than groups that do not. In this circumstance, cooperation leads to better growth and survival for cells. The challenge for biologists is answering this question: why wouldn't some cells evolve to become "freeloaders," not sharing with other cells but just exploiting their neighbors' generosity to grow and reproduce themselves? In the early evolution of multicellularity, cells might be just one mutation away from regressing to an uncooperative parasitism.

One hypothesis is that traits evolved among cells in such a way that they not only helped each other, but actually came to *depend* on each other, making unicellular backsliding risky or fatal. For example, a group of cells might divide up the job of making essential molecules, with certain cells making one necessary compound while others generated different ones. If a cell left the group to go it alone, it would now lack certain chemicals necessary to live. Recent experiments on bacteria suggest that when cells cooperate like this, they do better together than they do on their own.

Given the diversity of life on Earth, being single-celled or multicellular both have advantages. Single-celled organisms are older and more abundant, and they can reproduce rapidly. Bacteria can divide in as little time as 12 minutes! Multicellular organisms are more complex, with many systems that can go wrong, but may be more mobile and adaptable. Somewhere along the way, cells learned to cooperate with one another, like bees in a beehive. Scientists continue to search for answers that explain how these miraculous levels of cooperation came about.