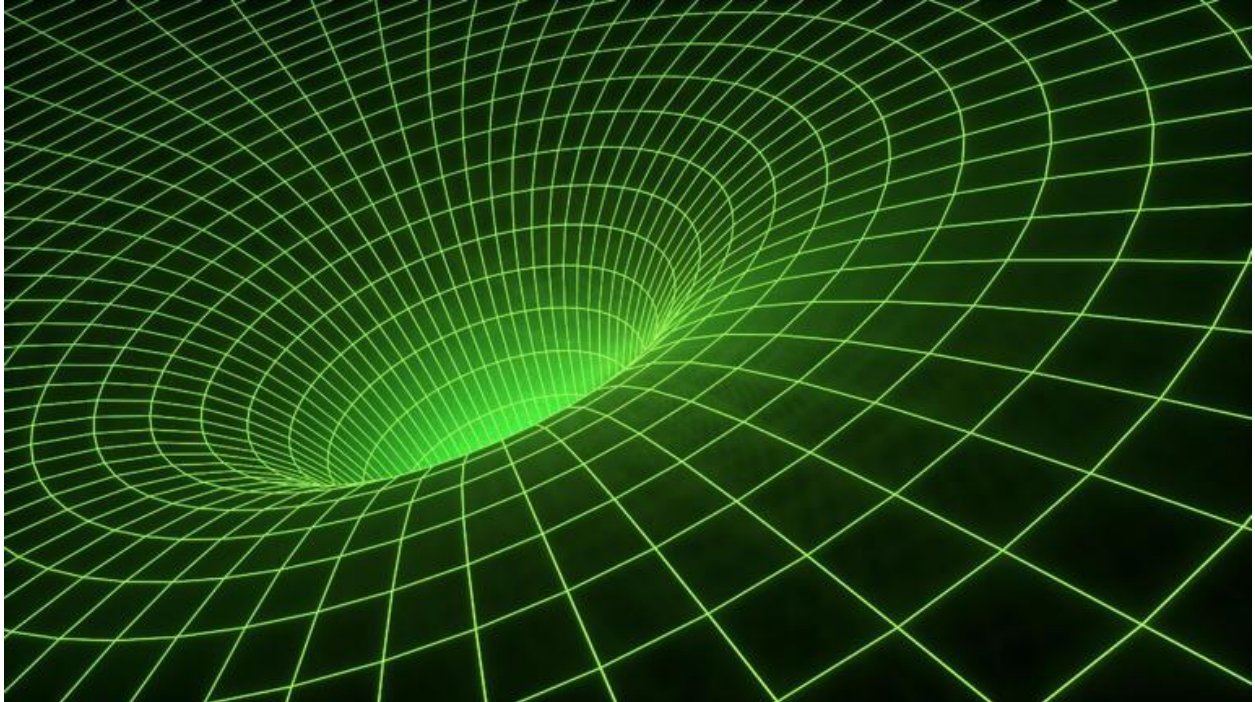


# Space-time doesn't exist, but it's a useful framework for understanding our reality



Whether space-time exists should be neither controversial nor even conceptually challenging, given the definitions of "space-time," "events" and "instants." The idea that space-time exists is no more viable than the [outdated belief that the celestial sphere exists](#): both are observer-centered models that are powerful and convenient for describing the world, but neither represents reality itself. Yet from the standpoints of modern [physics](#), [philosophy](#), [popular science communication](#) , and familiar themes in [science fiction](#), stating that space-time does not exist is contentious. But what would it mean for a world where everything that has ever happened or will happen somehow "exists" now as part of an interwoven fabric?

## Events are not locations

It's easy to imagine past events—like losing a tooth or receiving good news—as existing somewhere. Fictional representations of time travel [underscore this](#): time travelers alter events and disrupt the timeline, as if past and future events were locations one could visit with the right technology.

Philosophers often talk this way, too. [Eternalism](#) says all events across all time exist. The growing block view suggests the past and present exist, while the future will come to

be. **Presentism** says only the present exists, while the past used to exist and the future will when it happens. And **general relativity** presents a four-dimensional continuum that bends and curves—we tend to imagine that continuum of events as really existing. The confusion emerges from the definition of the word "exist." With space-time, it's applied uncritically to a mathematical description of happenings, turning a model into an ontological theory on the nature of being.

### **A totality**

In physics, **space-time** is the continuous set of events that happen throughout space and time—from here to the furthest galaxy, from the Big Bang to the far future. It is a four-dimensional map that records and measures where and when everything happens. In physics, an event is an instantaneous occurrence at a specific place and time. An instant is the three-dimensional collection of spatially separated events that happen "at the same time" (with relativity's usual caveat that simultaneity depends on one's relative state of rest).

Space-time is the totality of all events that have ever happened. It's also our most powerful way of cataloging the world's happenings. That cataloging is indispensable, but the words and concepts we use for it matter. There are infinitely many points in the three dimensions of space, and at every instant as time passes, a unique event occurs at each location.

### **Positionings throughout time**

Physicists describe a car traveling straight at constant speed with a simple **space-time diagram**: position on one axis, time on the other. Instants stack together to form a two-dimensional space-time. The car's position is a point within each instant, and those points join to form a worldline—the full record of the car's position throughout the time interval, whose slope is the car's speed. Real motion is far more complex. The car rides along on a rotating Earth orbiting the sun, which orbits the Milky Way as it drifts through the local universe. Plotting the car's position at every instant ultimately requires four-dimensional space-time. Space-time is the map of where and when events happen. A worldline is the record of every event that occurs throughout one's life. The key question is whether the map—or all the events it draws together at once—should be said to exist in the same way that cars, people and the places they go exist.

### **Objects exist**

Consider **what "exist" means**. Objects, buildings, people, cities, planets, galaxies exist—they are either places or occupy places, enduring there over intervals of time. They persist through changes and can be encountered repeatedly. Treating occurrences as things that exist smuggles confusion into our language and concepts. When analyzing space-time, do

events, instants, worldlines, or even space-time as a whole exist in the same sense as places and people? Or is it more accurate to say that events happen in an existing world?

In that view, space-time is the map that records those happenings, allowing us to describe the spatial and temporal relationships between them.

### **Space-time does not exist**

Events do not exist; they happen. Consequently, space-time does not exist. Events happen everywhere throughout the course of existence, and the occurrence of an event is categorically different from the existence of anything—whether object, place, or concept.

First, there is no empirical evidence that any past, present, or future event "exists" in the way that things in the world around us exist. Verifying the existence of an event as an ongoing object would require something like a time machine to go and observe it now. Even present events cannot be verified as ongoing things that exist. In contrast, material objects exist. Time-travel paradoxes rest on the false premise that events exist as revisitable locations. Recognizing the categorical difference between occurrence and existence resolves these paradoxes.

Second, this recognition reframes the [philosophy of time](#). Much debate over the past century has treated events as [things that exist](#). Philosophers then focus on their tense properties: is an event past, present, or future? Did this one occur earlier or later than that one? These discussions rely on an assumption that events are existent things that bear these properties. From there, it's a short step to the conclusion that time is unreal or that the passage of time is an illusion, on the identification that the same event can be labeled differently from different standpoints. But [the ontological distinction was lost at the start](#): events don't exist, they happen. Tense and order are features of how happenings relate within an existing world, not properties of existent objects.

Finally, consider relativity. It is a [mathematical theory](#) that describes a four-dimensional space-time continuum, and not a theory about a four-dimensional thing that exists—that, in the course of its own existence, bends and warps due to gravity.

### **Conceptual clarity**

Physics can't actually describe space-time itself as something that actually exists, nor can it account for any change it might experience as an existing thing. Space-time provides a powerful description of how events happen: how they are ordered relative to one another, how sequences of events are measured to unfold, and how lengths are measured in different reference frames. If we stop saying that events—and space-time—exist, we recover conceptual clarity without sacrificing a single prediction.