

The Nature of Time, Energy, and Light

1. Time as a Manifestation of Energy Transfer

Time can be understood as a measure of **energy transfer** or **dissipation** within a system. In the absence of any change — that is, if no energy is exchanged, transformed, or lost — the concept of time becomes meaningless.

Light serves as the most fundamental mediator of energy exchange. Each photon, with energy

$$E = hv,$$

where h is Planck's constant and v is the frequency, represents a quantum of change.

Thus, the **progression of time** emerges from the continual transformation of energy states. Time does not exist apart from motion or interaction; it is a **parameter tracing the unfolding of energy's dynamics**.

2. Light as an Information Carrier

Light, the messenger of the universe, carries not only energy but also **information**. When photons interact with matter, they encode details of its structure, color, and motion. Our eyes and brain decode these quantum messages, reconstructing the visible universe.

As Einstein wrote in *Relativity: The Special and the General Theory*,

"For us, space and time are modes by which we think, not conditions in which we live."

Our perception of **space-time** is therefore rooted in how energy (through light) communicates **change** to our consciousness.

3. Energy Exhaustion and the Experience of Time

From a thermodynamic standpoint, time's arrow aligns with the **increase of entropy (S)**, as stated in the Second Law of Thermodynamics:

$$\Delta S \geq 0 ,$$

Entropy represents the dispersion of usable energy. When energy spreads irreversibly, we perceive the "forward" passage of time.

On a biological scale, time feels like the rate at which we **expend energy**.

Organisms that conserve energy more efficiently — whose entropy increases slowly —

experience longer lifespans.

Thus, **the endurance of time** is directly tied to **the endurance of energy balance**.

4. The Twin Clocks and Time Dilation

In relativity, the rate at which time passes depends on **velocity** and **gravitational potential**.

For a moving clock, Einstein derived the relation:

$$\Delta t' = \Delta t / \sqrt{1 - (v/c)^2}$$

where $\Delta t'$ is the dilated time, v the velocity, and c the speed of light.

Hence, a clock on a plane — higher in altitude but moving fast — experiences both gravitational and velocity-based time dilation.

On an intuitive level, one might see this as the plane's clock **possessing different energy states**: increased potential energy, dynamic forces, and altered molecular vibrations.

Yet fundamentally, it is the **geometry of spacetime** that governs this variance, not internal energy itself.

5. The Fabric of Time is Woven by Energy

Time is not an external absolute entity; it is a **trace of change** driven by energy exchange.

When energy flows, time progresses.

When energy is conserved or halted, time slows or becomes undefined — a notion echoed in the physics of **absolute zero**, where all motion ceases.

In this sense, time, energy, and light form a **triadic unity**:

- Energy transforms,
 - Light carries it,
 - And time measures its unfolding.
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6. Final Reflection

"Time does not flow by itself; it is the shadow cast by energy moving through the universe."

To preserve time is to conserve energy; to lose time is to exhaust it."

References

- Book by Albert Einstein : *Relativity: The Special and the General Theory*, 1916.