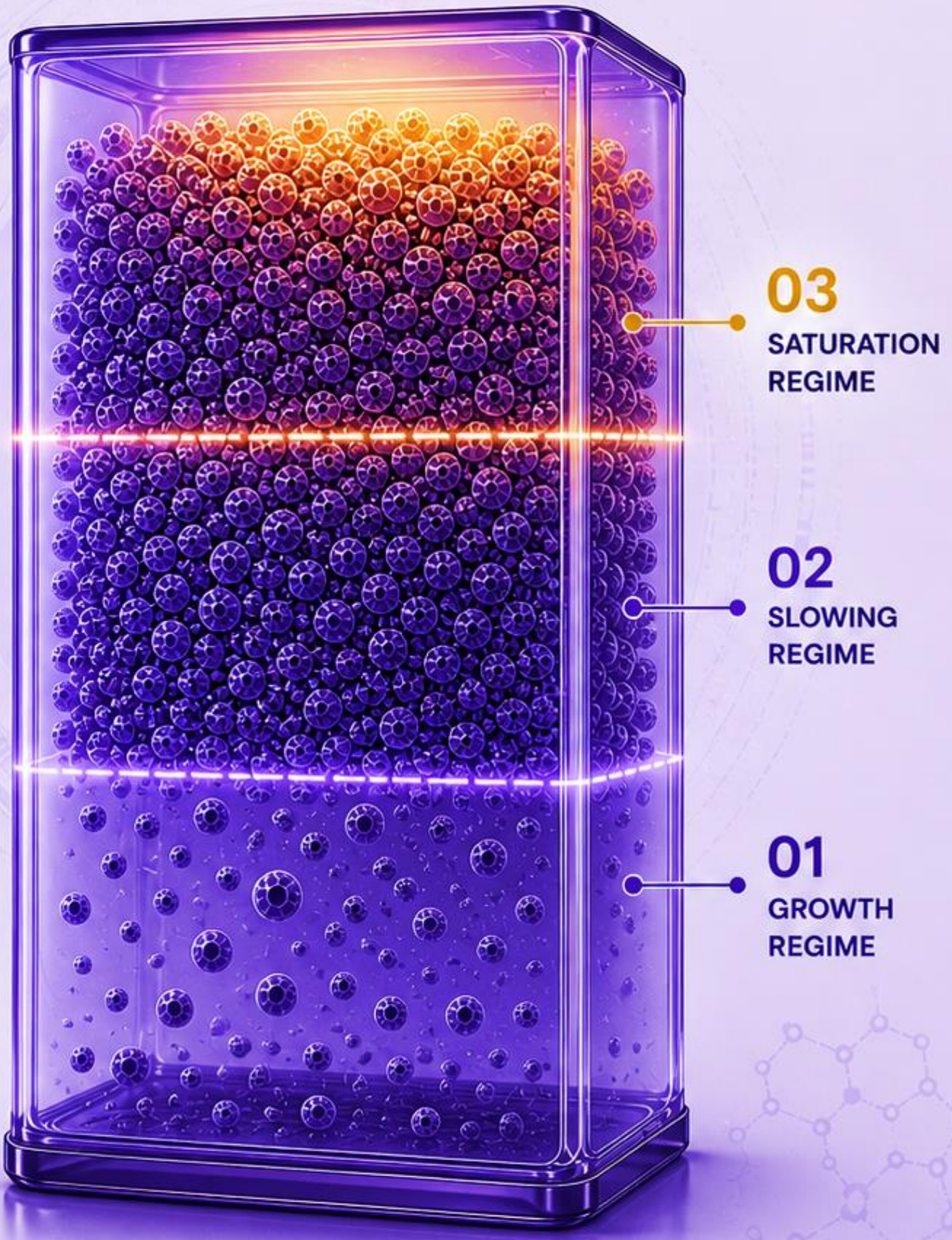
BIOLOGY

GROWTH UNDER CONSTRAINT

Biological populations grown in confined environments often exhibit slowed or halted growth even when nutrients are initially sufficient. Investigate how the dominant factors limiting growth evolve over time in confined biological systems. Identify and characterize distinct growth regimes, and determine the conditions under which transitions between them occur.



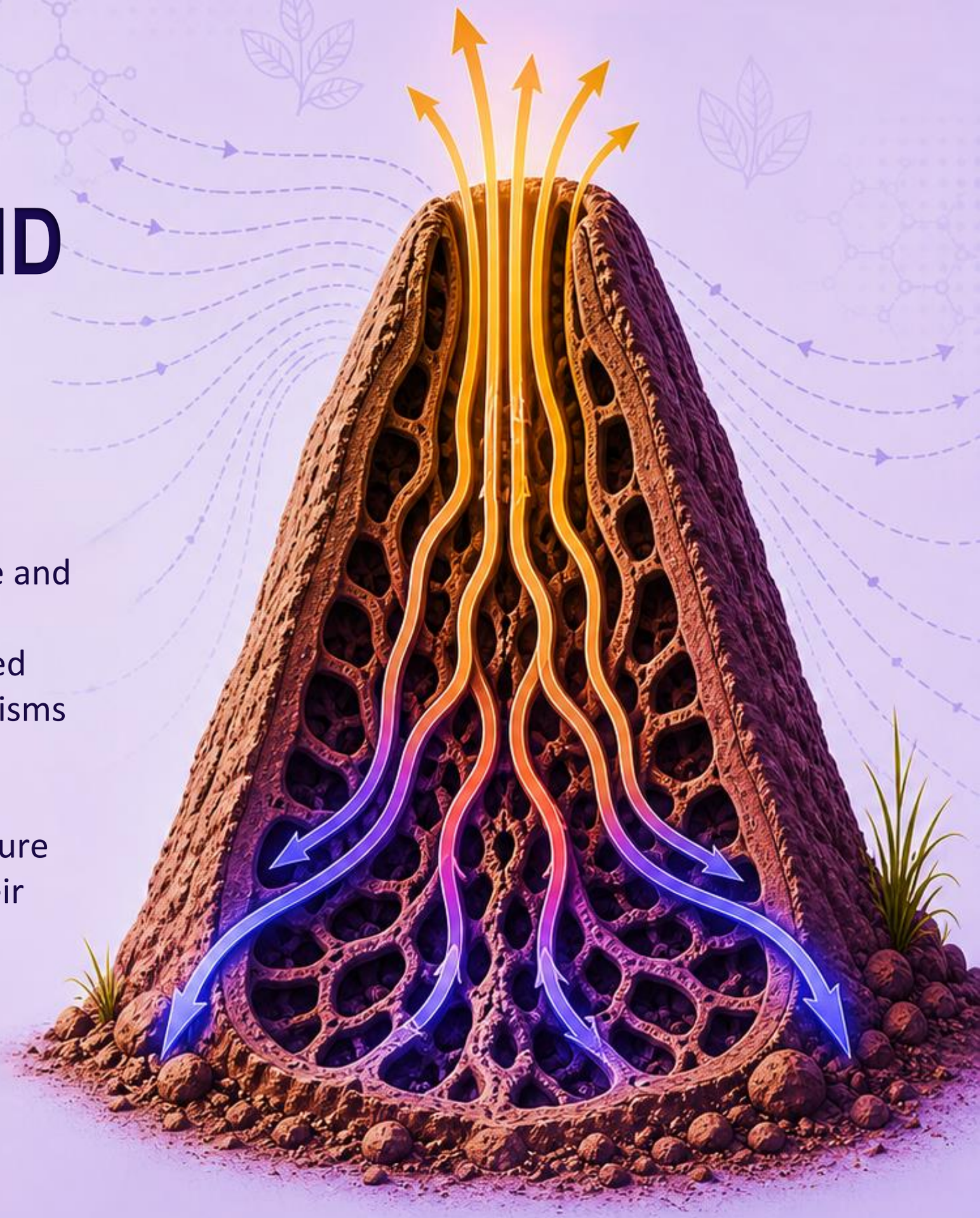
RESEARCH CUE:
When does growth stop, and why does it change?

ONE HIVE. ENDLESS POSSIBILITIES

BIOLOGY

TERMITE MOUND VENTILATION

Certain biological structures, such as termite mounds (ekiswa), maintain relatively stable internal temperature and gas composition despite fluctuating external conditions. Develop simplified physical models to study the mechanisms responsible for airflow and thermal regulation in mound-like structures. Evaluate how well these models capture real-world behaviour and identify their limitations.



RESEARCH CUE:
How does the mound breathe, & what controls it?

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CHEMISTRY

METAL RUSTING PATTERNS

When metal objects rust, corrosion often appears uneven, forming distinct patterns rather than spreading uniformly. Examine how interactions between environmental conditions and electrochemical processes lead to the emergence of spatial corrosion patterns. Determine the key factors controlling pattern formation and evolution.



RESEARCH CUE:
Why does rust form patterns, & what controls them?

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CHEMISTRY

LAYERING OF MISCIBLE LIQUIDS

Liquids that are fully miscible can temporarily form distinct layers when combined under controlled conditions. Investigate the competition between diffusion, density-driven stability, and convective instabilities in miscible liquid systems. Determine the conditions under which transient stratification persists or breaks down.



RESEARCH CUE:
When do liquids stay layered, & when do they mix?

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PHYSICS

SPILL RESISTANT CUP

Carrying a cup of liquid while walking often leads to spilling, yet certain motion patterns reduce spillage. Study how the interaction between imposed motion and the natural dynamics of the liquid influences sloshing. Determine conditions under which spillage is minimized and explain the underlying principles.



RESEARCH CUE:
When do liquids stay layered, & when do they mix?

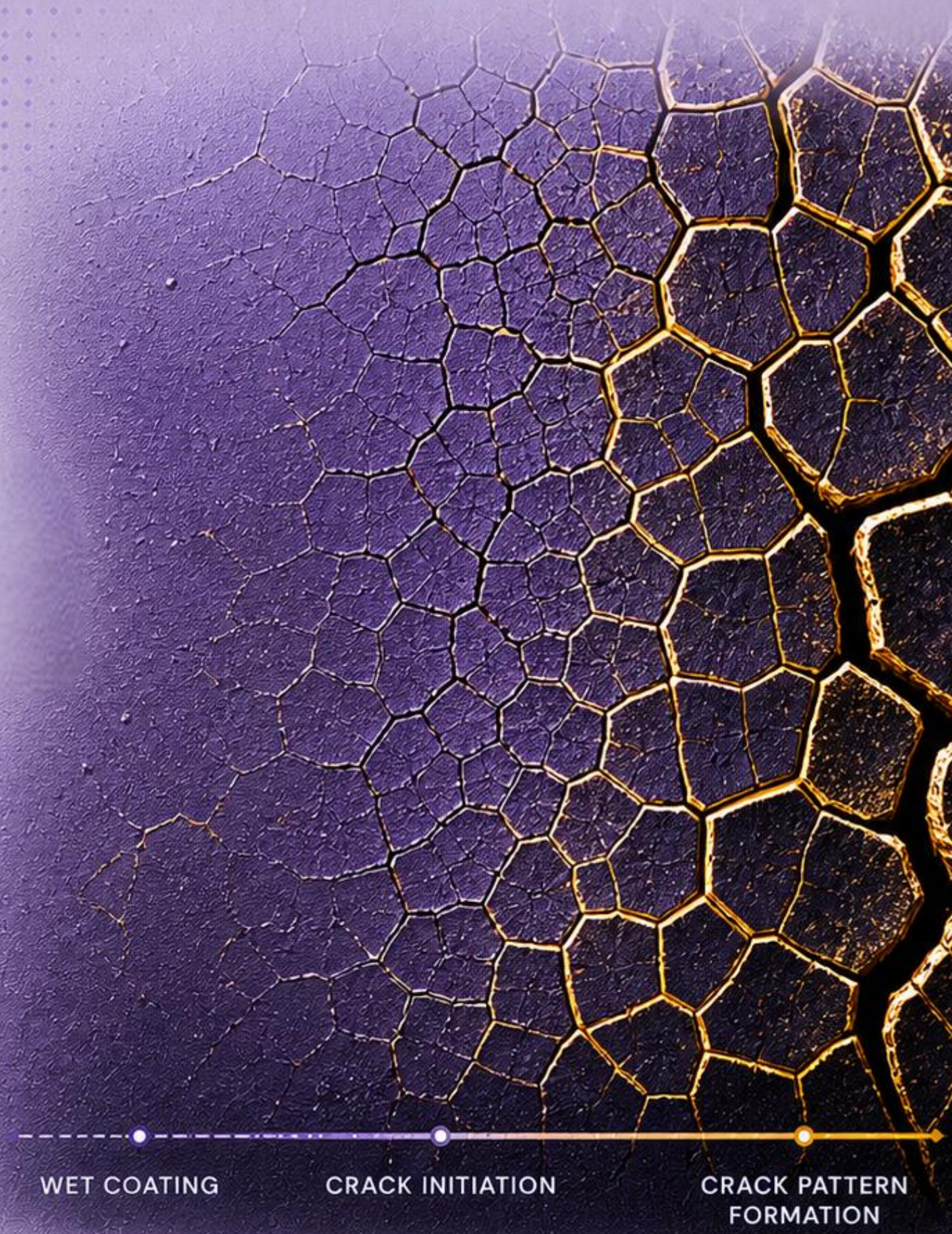
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PHYSICS

PATTERNS IN CRACKING

When coatings such as paint or mud dry, they often develop cracks whose patterns depend on material and environmental conditions. Investigate the conditions under which cracking occurs in drying coatings. Determine how material properties and external constraints influence crack initiation and pattern formation.

RESEARCH CUE:
Why do cracks form, & what controls their patterns?



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