Space Biology Knowledge Engine - Spacemates

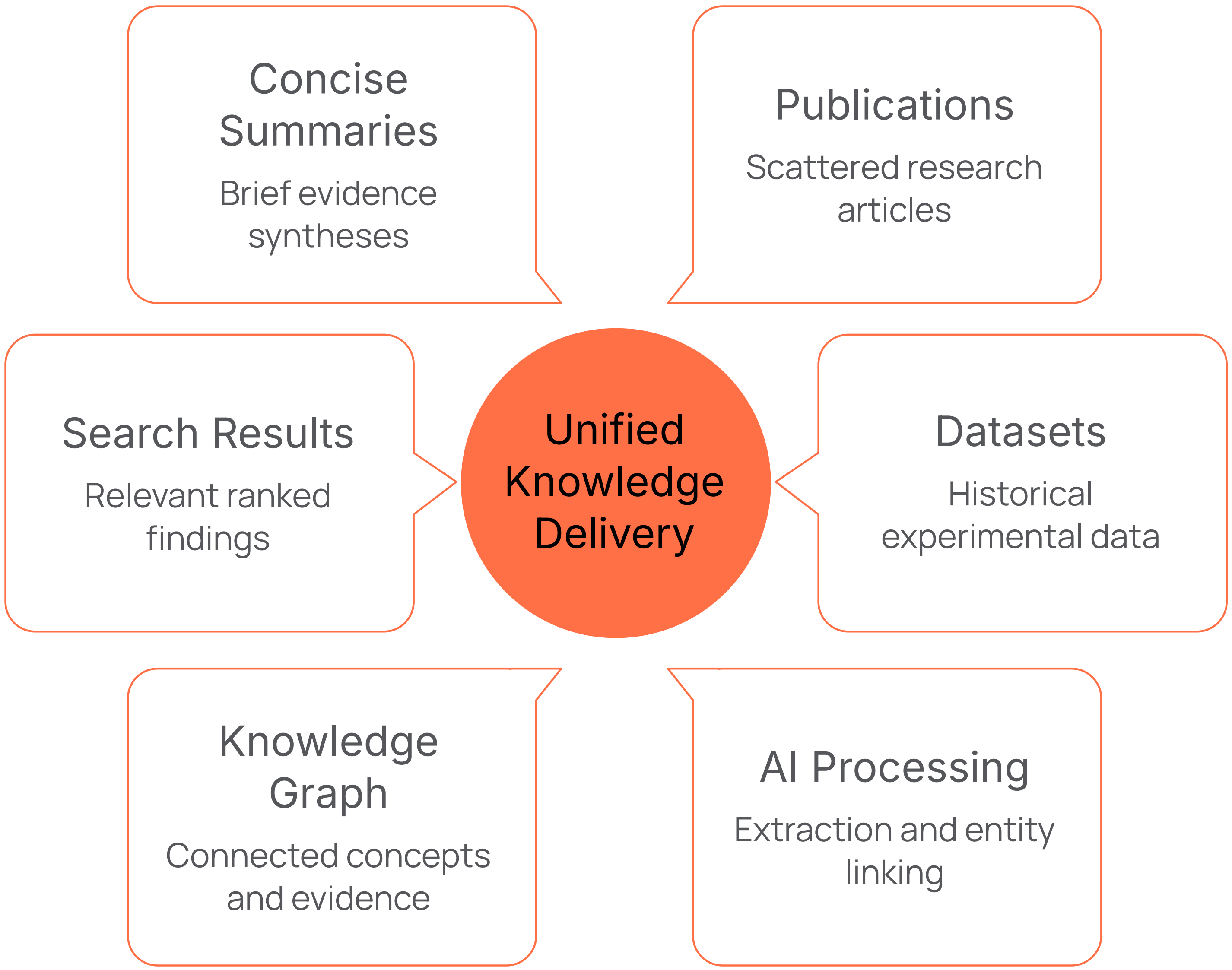
A web app that leverages AI and a knowledge graph to summarize and explore NASA's 608 bioscience publications. This tool unifies scattered research on space biology experiments, making it easier to discover connections, impacts, and results across missions.

Repository:-

https://github.com/ChowdharyYash/NASA_Space_Apps.git

The Challenge in Space Biology Research

NASA's decades of space biology research span hundreds of publications and datasets, often scattered across repositories. This fragmentation makes it difficult for users to quickly identify connections, key findings, and patterns in experiments involving organisms, missions, and environmental exposures.



Our objective: Develop a user-friendly knowledge engine that ingests these sources, applies AI for summarization, and builds a graph to reveal relationships across missions, organisms, exposures, methods, and outcomes.

Target Users and Their Needs

The app serves diverse users: research scientists seeking deep insights, mission planners integrating biology data, educators teaching space adaptation, and students exploring real experiments.

As a Scientist

I want to find rodent and plant studies on microgravity-induced bone or gene-expression changes, grouped by mission and method, to accelerate my research.

As an Educator

I want to show students concise summaries and images of how organisms adapt in space, with clear examples from actual missions, to make lessons engaging and informative.

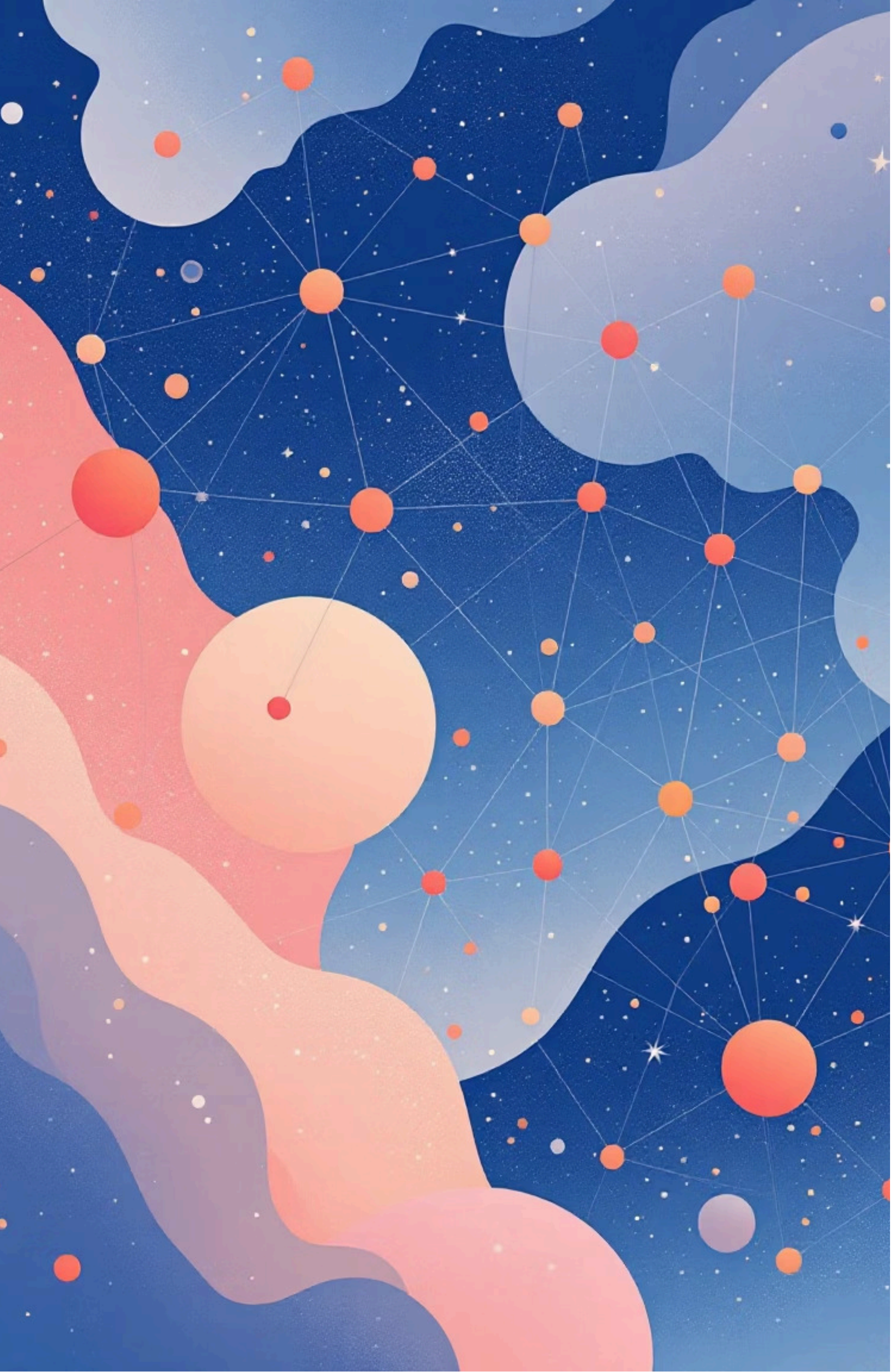
Success criteria include faster time-to-answer queries, clean cross-links between papers, and trustworthy AI-generated summaries always linked to original sources.

Data Foundation and Scope

Core dataset: The official NASA repository of approximately 608 bioscience publications (link: NASA Life Sciences Data Archive). We begin with titles and abstracts for quick ingestion, expanding to full texts later.

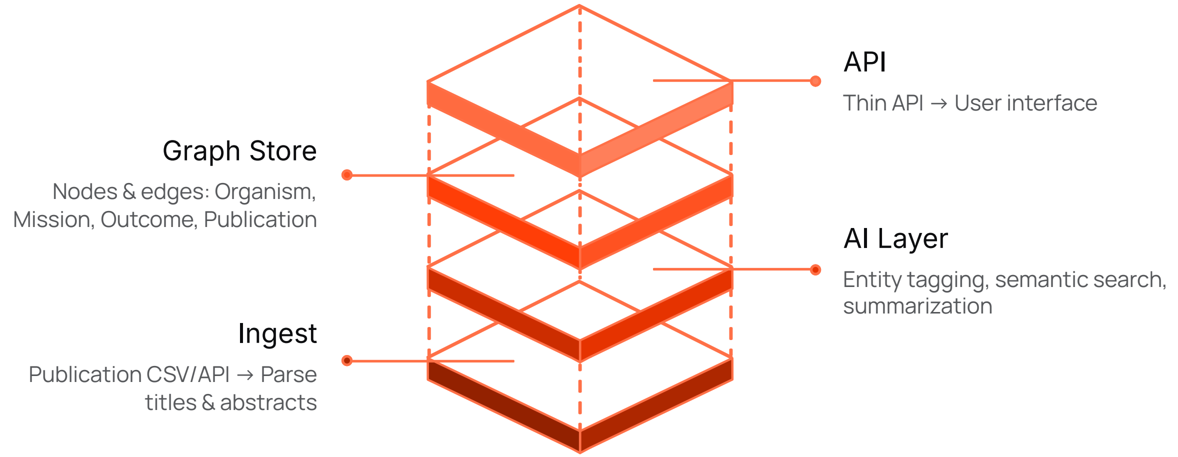
Entity Type	Organism	Mission	Exposure	Method	Outcome	Publication
Description	(e.g., Mouse, Arabidopsis)	(e.g., ISS, SpaceX)	(Microgravity, Radiation)	(RNA-seq, Microarray)	(Bone loss, Immune response)	(Journal article link)

Future expansions draw from open resources like GeneLab/OSDR metadata, mission logs, and experiment records to enrich the graph with detailed biological signals.



System Architecture

For a hackathon-ready prototype, we use Python for backend processing, embeddings for semantic analysis, lightweight rules for tagging missions and organisms, and a simple Neo4j graph store or relational database.



The flow ensures efficient data handling: Raw publications feed into AI for extraction, populate the knowledge graph for relationships, and deliver via a clean API to an intuitive web frontend.

AI-Powered Insights

AI methods include semantic search for relevant papers, auto-tagging of entities like organisms and outcomes, and hybrid extractive-abstractive summaries with inline citations to maintain traceability.

Example Query: Microgravity Effects on Rodent Bone

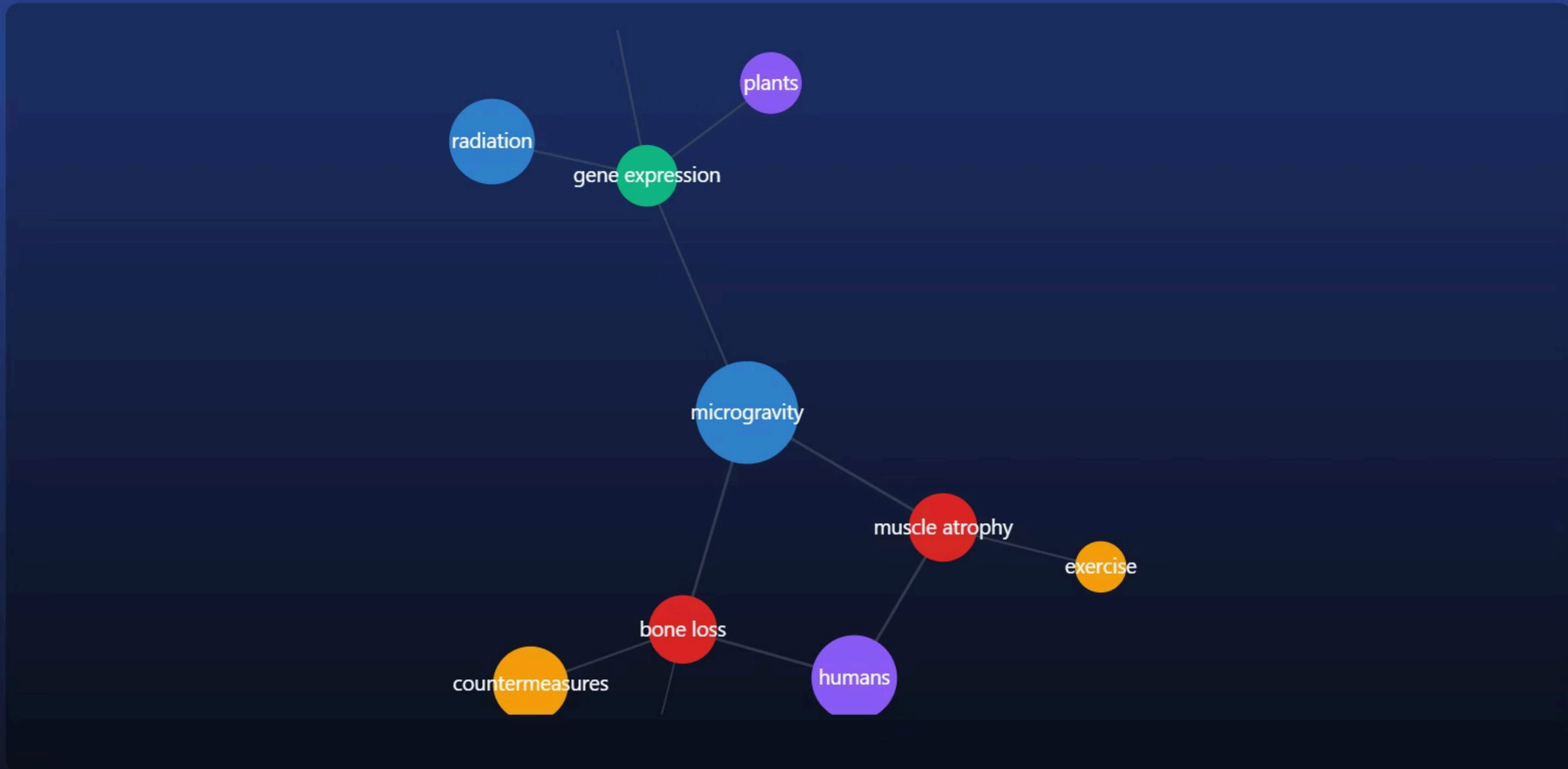
Microgravity exposure in rodents leads to rapid bone density loss, primarily in trabecular bone, due to disrupted osteoblast and osteoclast activity. (Sources: Publication IDs 245, 312, 478)

Example Query: Arabidopsis Response in Space

Arabidopsis thaliana exhibits altered gene expression and growth patterns under space conditions, including enhanced phototropism and stress responses to microgravity. (Sources: Publication IDs 156, 289, 501)

Early signals from the dataset highlight frequent elements: Organisms (mouse, Arabidopsis), exposures (microgravity, radiation), outcomes (bone loss, muscle atrophy, immune changes).

Space Biology Knowledge Graph



Environment Effects Mechanisms Organisms Solutions