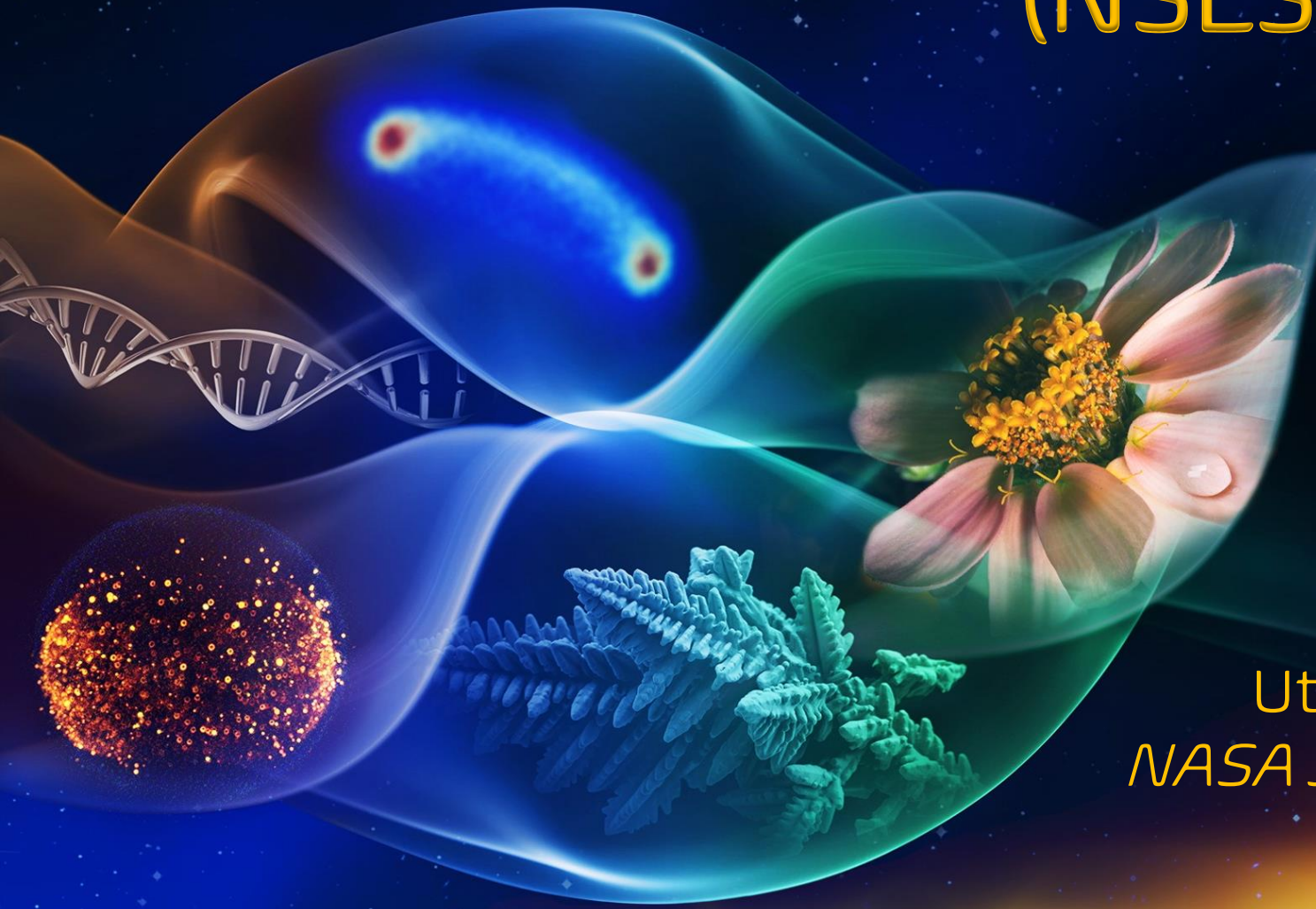
NASA Space Life Sciences Library (NSLSL)



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Research Retrospective

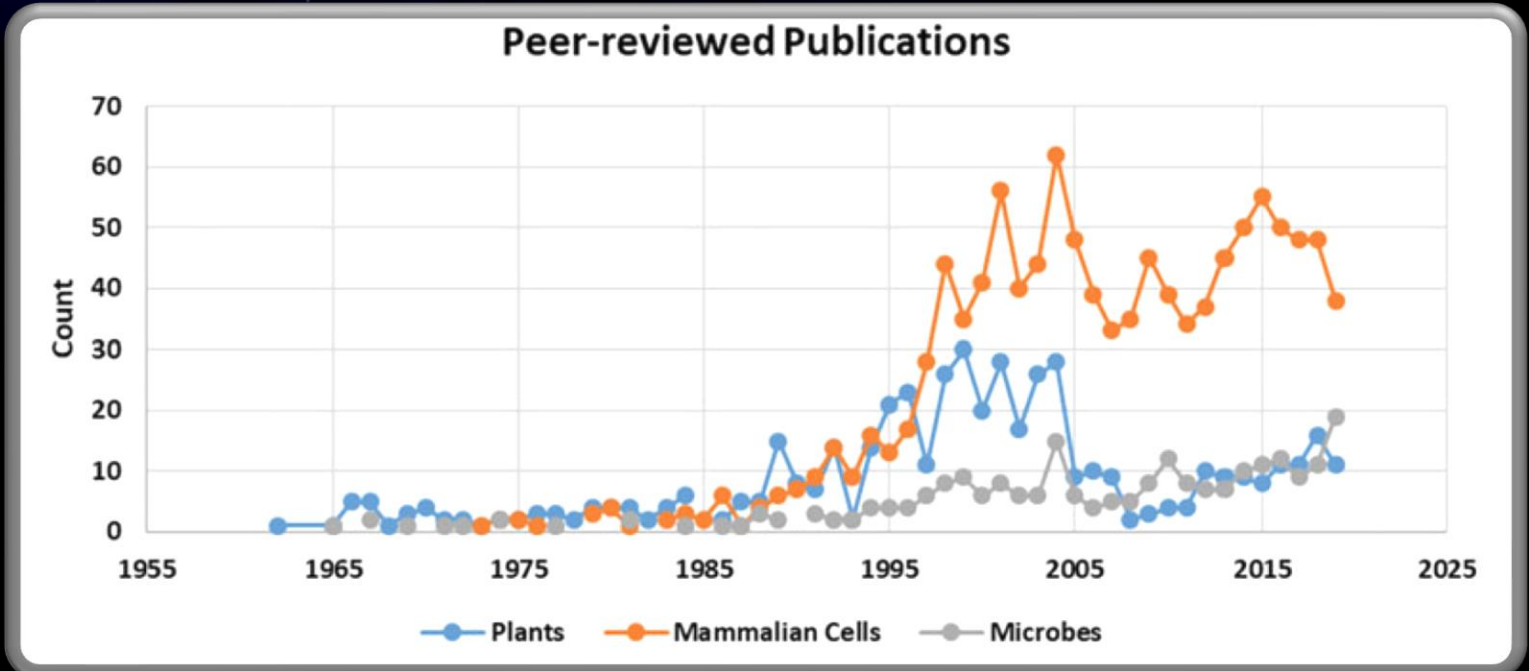
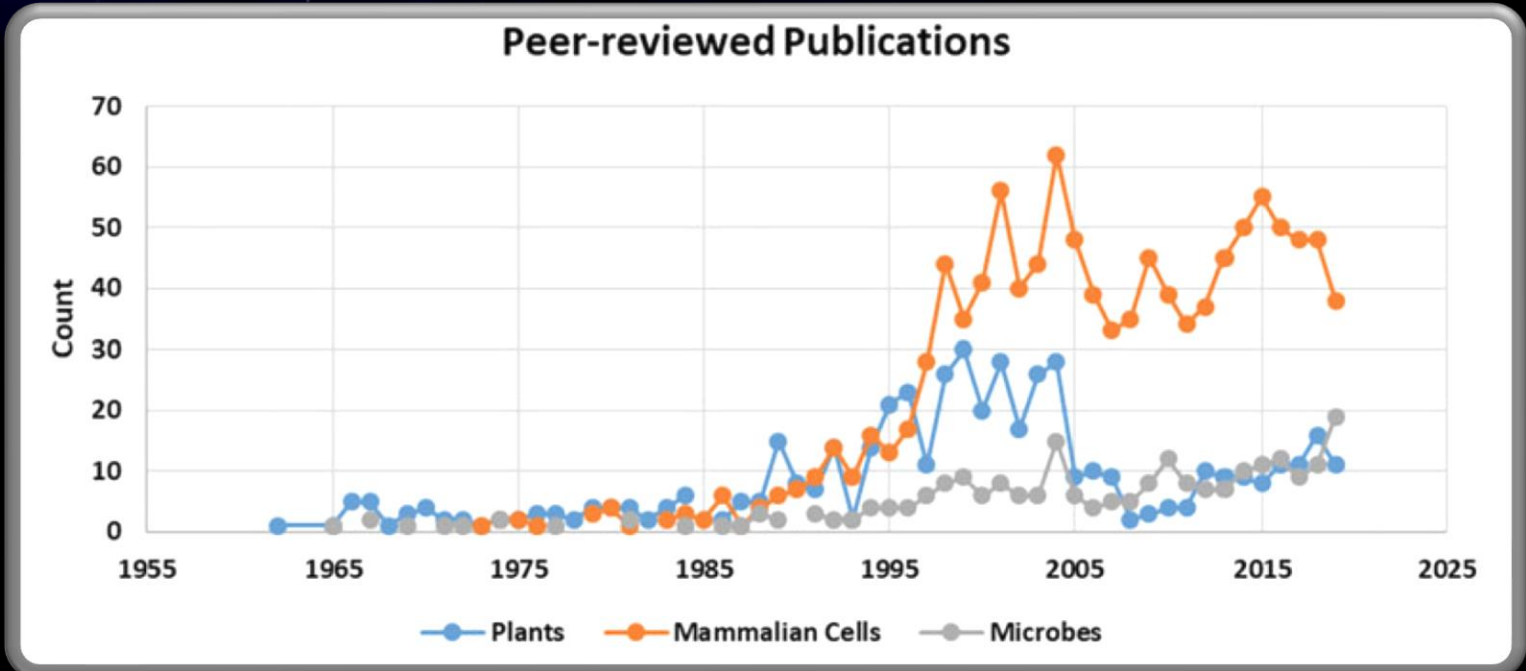


Fig. 1 A retrospective of life science research using simulated microgravity. Search keywords: *Plants* (477 entries) by combinations of "clinostat," "simulated microgravity," "microgravity analog," and "plant"; *Mammalian Cells* (1073 entries) by combinations of "clinostat," "simulated microgravity," "microgravity analog," and "mammalian cells"; and *Microbes* (271 entries) by combinations of "clinostat," "simulated microgravity," "microgravity analog," "microbial," "microbe," "biofilm," "bacteria," "fungi," and "virus"

- More than 5000 peer-reviewed articles have been published on studies using simulated microgravity conditions since 1961.
- Approximately 2000 of these studies investigated mammalian cell cultures, plants, and microbial cell cultures.
- We conducted a review of these 2000+ articles to gain insights into the trends of life sciences research using microgravity simulation devices.
- In-depth analysis in those in parallel with true microgravity platforms and those in combined effects.

Research Retrospective



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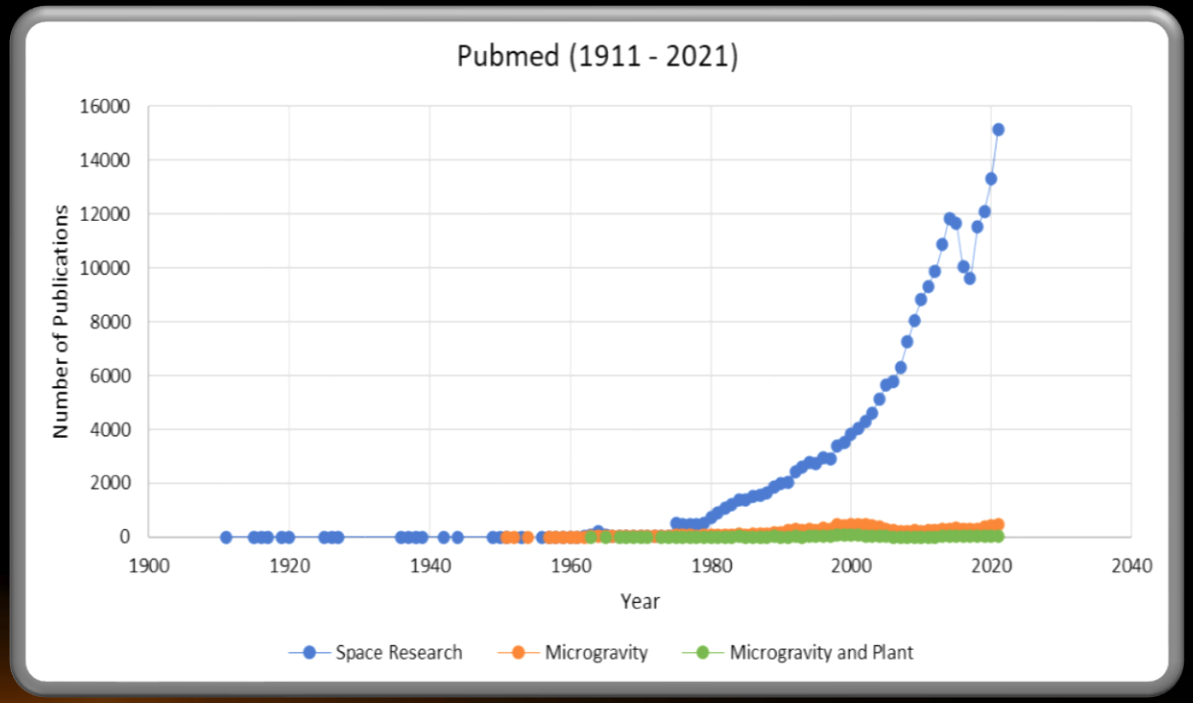
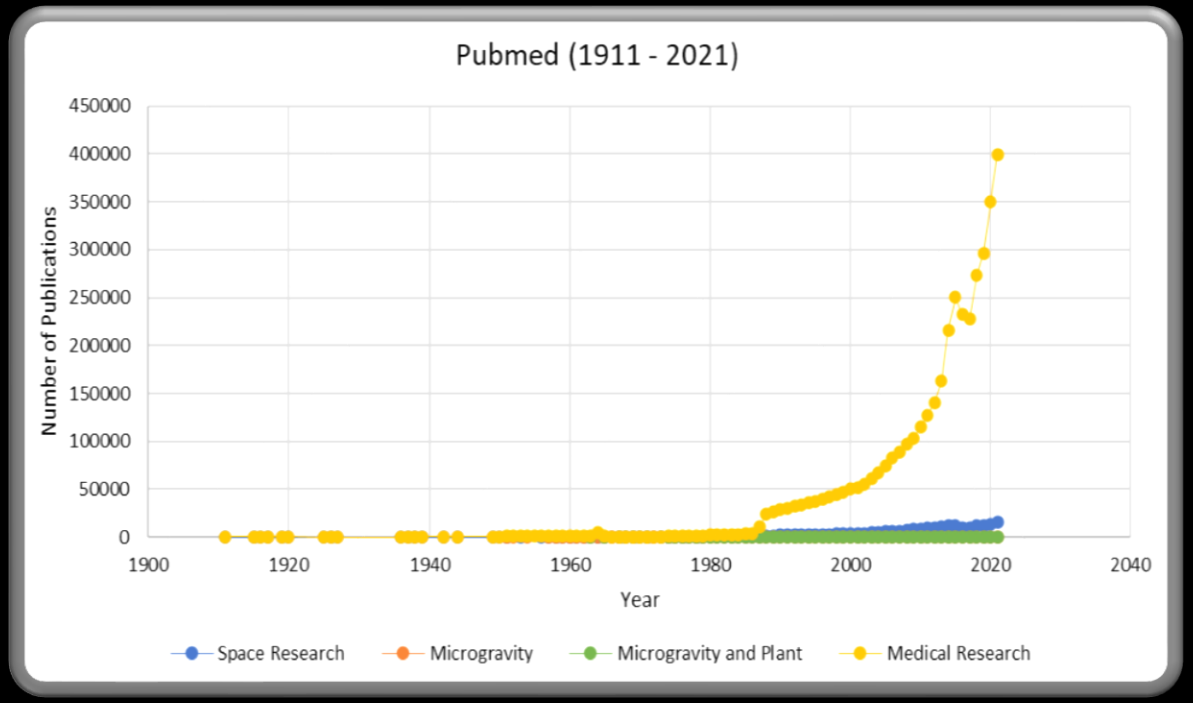
- More than 230 original research articles on simulated microgravity research with plants.
- 46 of these studies were performed using microgravity simulation devices in parallel comparisons with spaceflight experiments.
- Few studies have been reported on investigating the combined effects of simulated microgravity with other deep space environmental risk factors.
- Experimental parameters, e.g., the age of the plant, and the duration of the study, vary dramatically among plant studies, which makes in-depth comparisons between existing studies difficult.

Problem Statement

The Need for a Space Life Sciences Library

During data mining, we found that peer-reviewed space research articles were currently spread out over multiple databases and that many were not easily accessible.





Examples: *Data inaccessibility for microgravity research in PubMed within space research (left) in comparison to medical research (right).*

Our Solution

NASA Space Life Sciences Library (NSLSL)

THE SOLUTION: Development of a database serving as a central repository for hosting space life sciences research publications.

- Repository site for peer-review publications, dissertations, technical publications such as white papers, NASA technical publications, and patent publications.
- Accessible by all NASA personnel and open to the public.
- Interface with Pubmed/PubSpace/NTRS/STI (NASA Scientific and Technical Information).
- Extensive complex searching, sorting, and filtering of multiple fields, metadata, tags, keywords, etc.
- Users will have the capability of recommending literature to be added to the Library for approval.

Cost Efficiency, **Sustainability**, and **Expandability** are **Key**. Some existing infrastructures are *available.* A Design Analysis Report (DAR) report was provided by the KSC IT team in early 2022, and a system similar to NTRS/STI (https://www.sti.nasa.gov/) was recommended.

Project Life Cycle

NASA Space Life Sciences Library (NSLSL)

Development:

- The KSC Microgravity Simulation Support Facility (MSSF), with support from the KSC IT Applications Development Team and the NASA Space Biology Program, took the initiative to develop the NSLSL library.
- The development was funded by KSC Center Engineering, Safety, & Operations (CESO) Office and the Kick-Off meeting was held on Aug 04, 2022.
- Based on User Acceptance Testing (UAT) feedback, a total of nine sprints were developed to optimize database functionality and make the system more user-friendly.
- Many UATs involved multiple Centers, Programs, and Investigators.
- A trial release of the website and the Library were deployed to production on Aug 29, 2023.

Enhancement Development:

- After the trial release, two more sprints were funded by CESO to further enhance library functionality.

Operations & Maintenance (O&M):

- Infrastructure maintenance and operations is covered by CESO and Library administration is under BPS/SBP.

Key Features

NASA Space Life Sciences Library (NSLSL)

Key Features:

- The public-facing library is accessible to everyone. Users can search thousands of articles related to space life science research and submit new, relevant publications to be included in the library. Currently the NSLSL holds 250K+ entries.
- Entries include NASA and non-NASA funded research, space related peer-reviewed articles, dissertations, white papers, and technical publications.
- The library uses All Fields, Boolean, SQL, and combination field searches to allow the researchers to access the articles. There are 33 custom fields with a subset of 185+ unique values to filter by.
- The Library's companion website provides links to other NASA and space research resources and databases. It also includes a detailed User's Guide to help users navigate the Library.
- Investigators can also recommend articles, report bugs and issues, and submit suggestions and feedback.

NSLSL Team

KSC Key Project Team Members & Roles

NASA Development Team:

Lead IT Project Manager: Brandi Capps

EAST2 Development Team:

Product Owner: Rachel Zabin
SW Developer: Robin Anders
SW Developer: Carol Ann Schmutzler

UAT Participants:

More than 155+ internal and external researchers participated in User Acceptance Testing, and many provided feedback.

Customer/Stakeholder Team:

Lead and Project Scientist: Ye Zhang
Project Manager: Anna Maria Ruby
LASSO Leads: Bruce Link, Thomas Dreschel

Science Support Team:

BPS Portfolio Manager: Bryan Onate
BPS Portfolio Scientist: Elison Blancaflor
Project Scientists: Howard Levine, Aubrie Orourke, Raymond Wheeler, Gioia Massa, Jeffrey Richards, Alexander Meyers, Christina Johnson

Student Interns from 2020 to 2023:

Kevin Walsh, Rishi Raman, Tyler DeScenza, Lindsey Shimoda, Justin Davis, Susie Bennett, Rafael Rivera Vargas, Joseph Olivieri, Sahil Karim, Lauran-Ann Graham, Jessica Hellein, Jon Henry, Nick Syracuse, Mesgana Admassu, Karen Perkins

Other Center Communication:

Ames Research Center (ARC):

Matthew Lera, Jessica Lee, Elizabeth Keller, Alan Wood, Sylvian Costes, Danielle Lopez, Ryan Scott, Lauren Sanders

Johnson Space Center (JSC):

Antony Jeevarajan

Marshall Space Flight Center (MSFC):

Karen Stephens, Cassy Turner

Acknowledgements

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KSC Center Engineering, Safety, and Operations (CESO) Office