How can we use open space biology data to learn about plants?

Background

Plants surround us, whether they are part of our natural environment, serving as indoor décor, or waiting on our plates to be eaten. Yet people commonly only recognize charismatic plants or grocery store varieties. This attitude neglects understanding of plant anatomy and physiology, and the essential roles that plants serve for us. Although growing plants in space requires special care that differs from growing them on Earth, the Open Science Data Repository can be used to explore common types of plant model organisms, variables in experiments related to plants, and an engineering perspective on the equipment needed to grow plants in limited spaces (such as in increasing urban settings or in space).

Objectives

1) Navigate using the search tool of the Open Science Data Repository
2) Explore the breadth of plant datasets and the equipment used to generate or collect these data

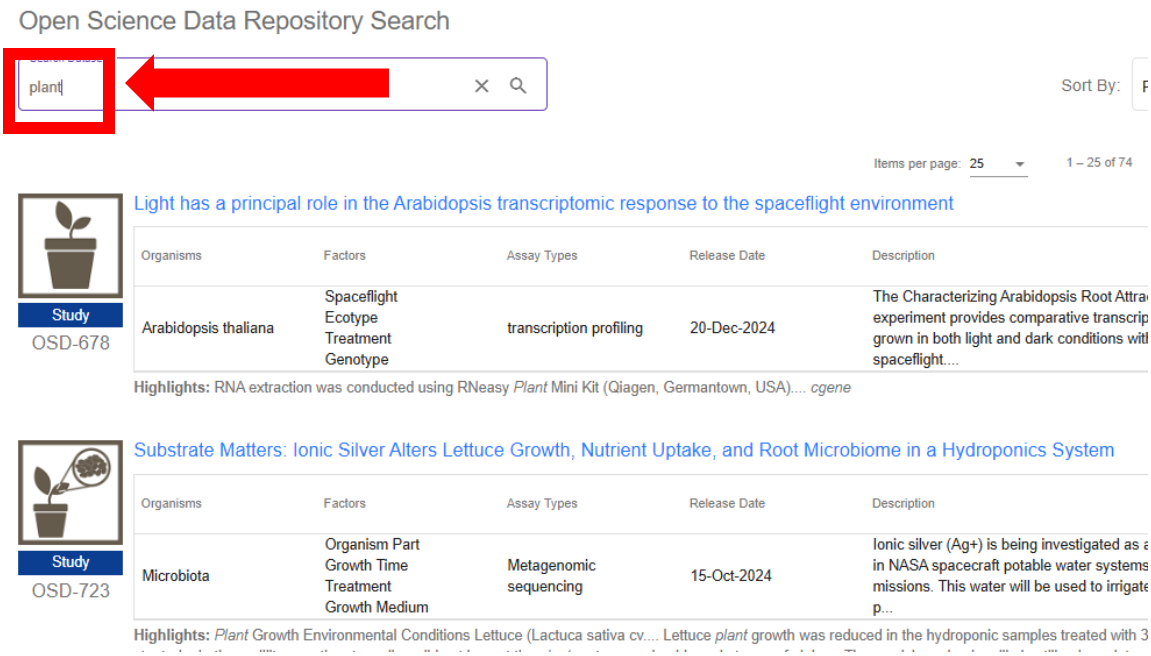
Datasets

For this activity, you will use the GeneLab Data Repository to look at datasets OSD-267, OSD-411, OSD-219, and OSD-269 as a survey of the breadth of plant data that is available for analysis.

Activity

1) Navigate to the Open Science Data Repository (https://www.nasa.gov/osdr/)
2) Scroll down and click on the *Explore the Data Repository* button

3) Type “plant” into the search bar.



4) What datasets do you see listed?

   (Answers may vary depending on new sets that have been made available since the time of publication of this activity. In this case, you can see OSD-678 and OSD-723 listed.)

5) Click on each of the datasets listed below. Review the metadata by navigating through the tabs for Description to collect the information listed.

OSD	Which Plant?	Which Parts of the Plant?	Hardware Platform or Equipment?
267			
411			
219			
269			

Guiding Questions

1) **What two icons tends to be used to denote plant studies? What is the difference between them and why do you think this is the case?**
   (potted plant icon or potted plant with pop out image of microbes; many plants rely on symbiotic relationships with microbes)
2) **What experimental platform is commonly used for plant studies? Describe the hardware associated with it. What unique engineering challenges do you think would need to be address for plant hardware?**
   (VEGGIE. Additional responses may vary, but challenges could include space constraints, temperature and humidity regulation, ability to keep plants hydrated, etc)
3) **At which NASA Center are many plant studies processed or associated?**

(Kennedy Space Center (KSC))

4) **Review OSD-267 again. What publication(s) was/were associated with this dataset? Describe or summarize the study.**
   (Microbiological and Nutritional Analysis of Lettuce Crops Grown on the International Space Station)
5) **Do you think watering plants in space is the same as on Earth? Why or why not?**
   (Responses will vary, but should be guided to consider that water behaves different in space than it does on Earth. Often this leads to water "sticking" along stems and leaves of plants and so special watering systems are needed)

Why Does This Matter?

Commonly cited space factors involve microgravity and radiation. However, those two factors are not as much of a problem on Earth as is the relative importance of crop nutrition or various agricultural factors. Likewise, astronauts need nutrition that includes vitamins, such as vitamin C, which is abundant in plants like chile peppers. The limited amount of space on board the International Space Station is also akin to living in a moderately-sized apartment, yet many plant experiments must be conducted in the space available. This idea can be applied to both urban living or potential future space base camps.

Extension

Investigate a variety of edible plants and herbs and research their nutritional values. Examine aspects such as which retain their properties when dried or which do well growing in confined spaces. Propose a menu of space vegetables.

(Answers will vary, but encourage creativity and thorough searches from reliable sources about nutrition)

Advanced Option: Find a study pertinent to one of plant datasets within the Open Science Data Repository that uses transcriptomics and analyze the set to identify genes that are upregulated in spaceflight.

NGSS Standards

Strands: HS-ETS1-3, HS-ESS3-4, HS-LS1-3

Practices: Analyzing and Interpreting Data; Using Mathematics and Computational Thinking; Construction Explanations and Designing Solutions

Crosscutting Concepts: Interdependence of Science, Engineering, and Technology; Influence of Engineering, Technology, and Science on Society and the Natural World