NASA
CubeSat Launch Initiative (CSLI)

Lessons Learned

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Launch Services Program

NASA-KSC

https://www.nasa.gov/kennedy/launch-services-program/cubesat-launch-initiative/

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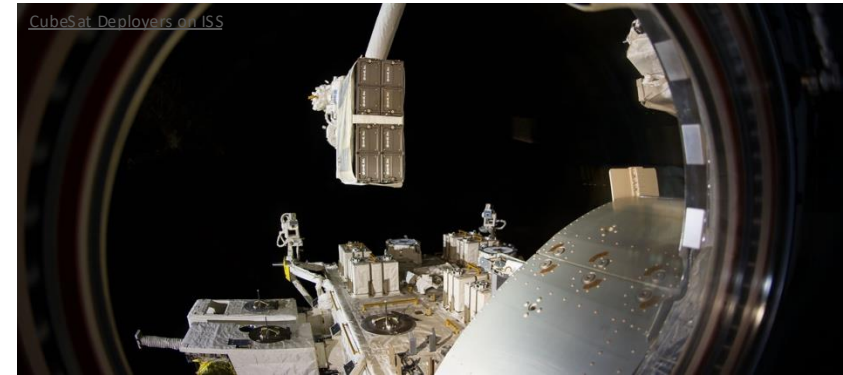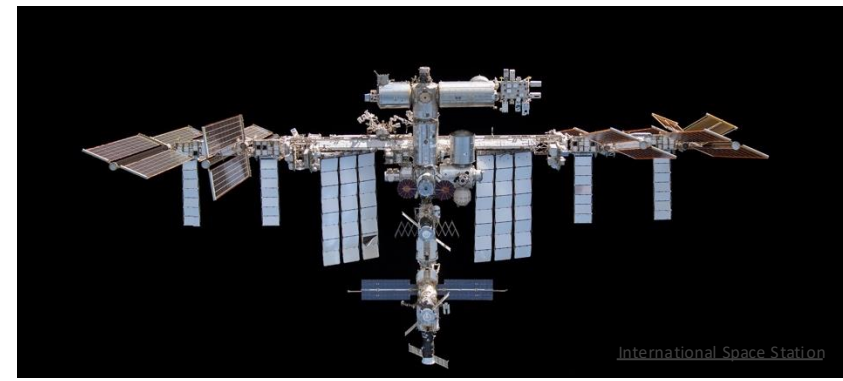# CubeSat Launch Initiative

NASA

Mission

Provide launch opportunities to U.S. CubeSat developers, thereby giving them a pathway to conduct research in the areas of science, exploration, technology development, and education.

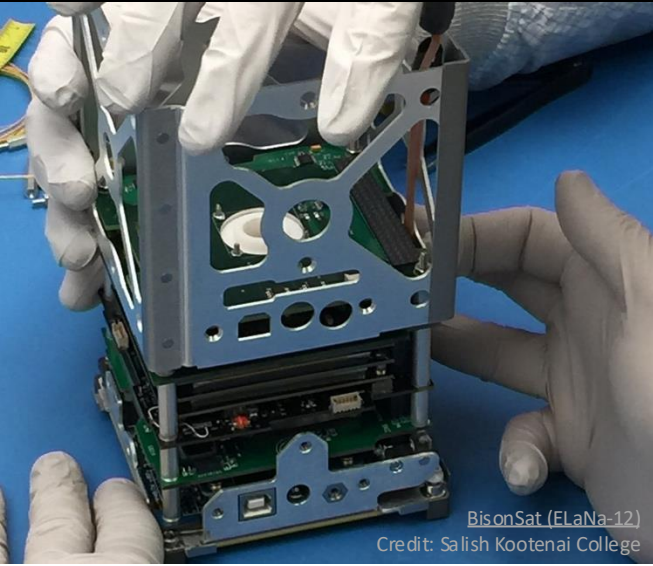LightSail, Credit: The Planetary Society

CubeSat Deployers on ISS

International Space Station

BisonSat (ELaNa-12)
Credit: Salish Kootenai College
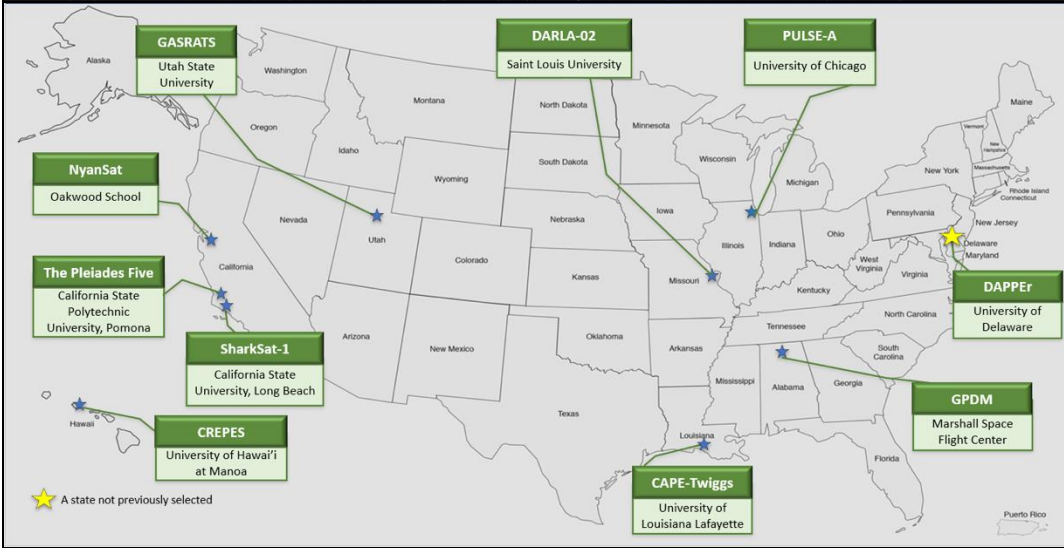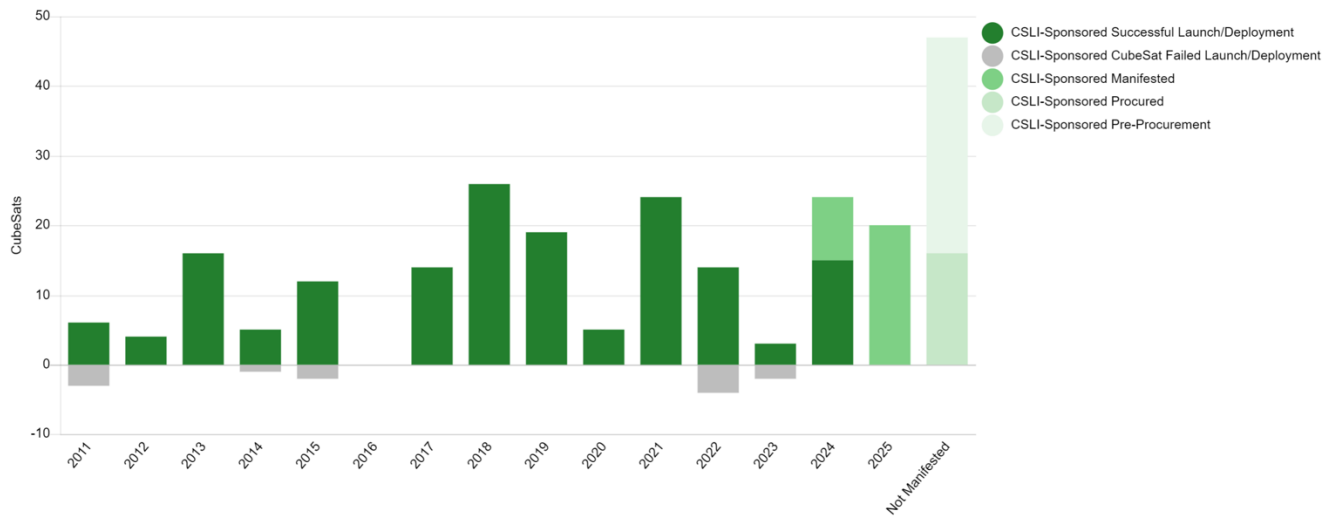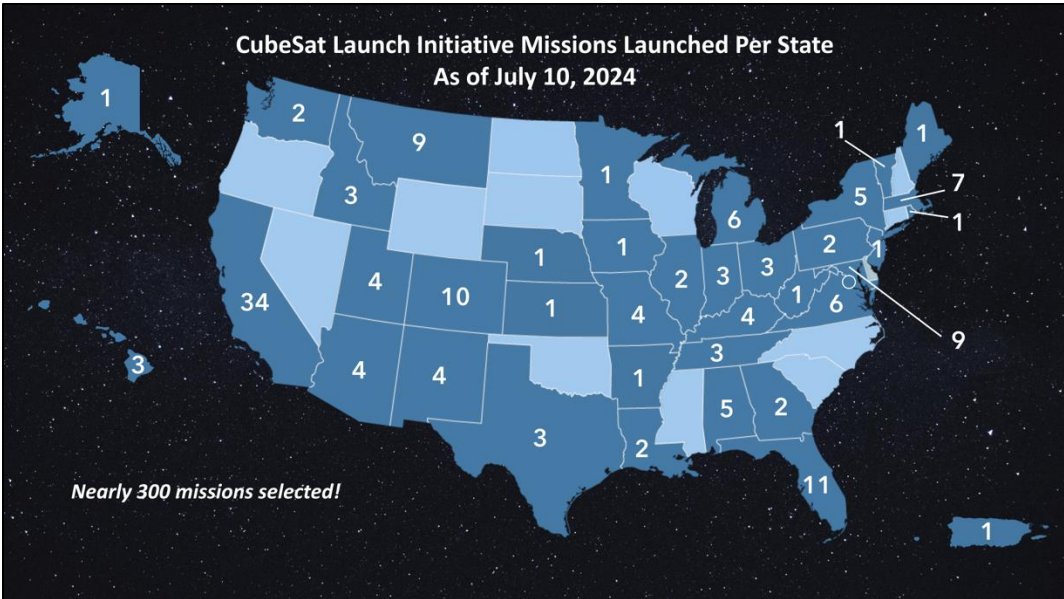
SC Team Designs/Builds/Tests their Spacecraft

NASA CSLI Procures and Funds* the Launch Service

SC Team Operates their Spacecraft

* Projects that are NASA funded and/or sponsored may be asked to provide matching funding if requirements exceed the baselined budget for integration and launch.
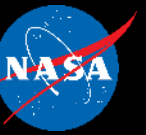
CSLI Progress

CubeSat Launch Initiative Missions Launched Per State
As of July 10, 2024

Nearly 300 missions selected!

Legend:
- CSLI-Sponsored Successful Launch/Deployment
- CSLI-Sponsored CubeSat Failed Launch/Deployment
- CSLI-Sponsored Manifested
- CSLI-Sponsored Procured
- CSLI-Sponsored Pre-Procurement

Nearly 300 CubeSat Projects from 100+ organizations selected from 42 states, Washington DC, and Puerto Rico

Successfully launched 162 CubeSats to date!

- GASRATS — Utah State University
- DARLA-02 — Saint Louis University
- PULSE-A — University of Chicago
- NyanSat — Oakwood School
- The Pleiades Five — California State Polytechnic University, Pomona
- SharkSat-1 — California State University, Long Beach
- CREPES — University of Hawai'i at Manoa
- DAPPEr — University of Delaware
- GPDM — Marshall Space Flight Center
- CAPE-Twiggs — University of Louisiana Lafayette

★ A state not previously selected

ELaNa 57, Transporter 10, Falcon 9, 3/4/2024

- M3, Missouri University of Science and Technology

ELaNa 51, Transporter 10, Falcon 9, 3/21/2024

- Big Red Sat-1 University of Nebraska at Lincoln
- BurstCube, NASA Goddard Space Flight Center
- HyTI, University of Hawaii at Manoa
- SNoOPI, Purdue University

ELaNa 43, VCLS Demo 2, Firefly Alpha ,7/3/2024

- CatSat, University of Arizona
- KUbeSat-1, University of Kansas - First from Kansas
- MESAT-1, University of Maine - First From Maine
- R5-S2-2.0, NASA Johnson Space Center
- R5-S4, NASA Johnson Space Center
- Serenity, Teachers in Space
- SOC-i, University of Washington
- TechEdSat-11, NASA Ames Research Center
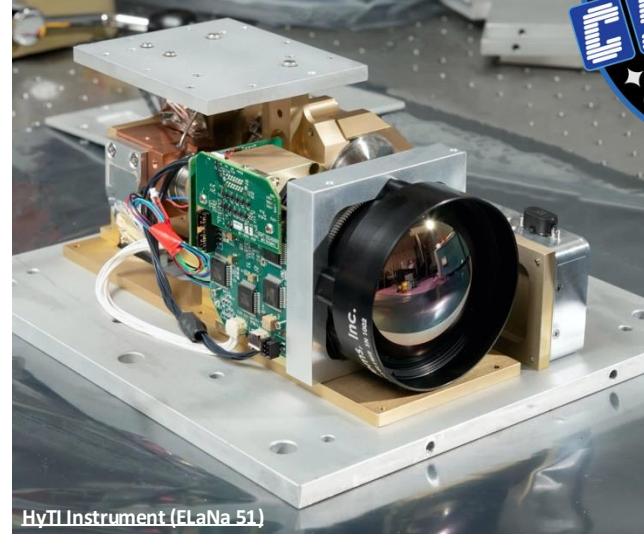
ELaNa 48, Ariane VI First Flight, 7/9/2024

- CURIE (Qty. 2), University of California at Berkely

SOC-i (ELaNa 43)

ELaNa 43 Launch
Credit: Firefly Aerospace/Trevor Mahlmann
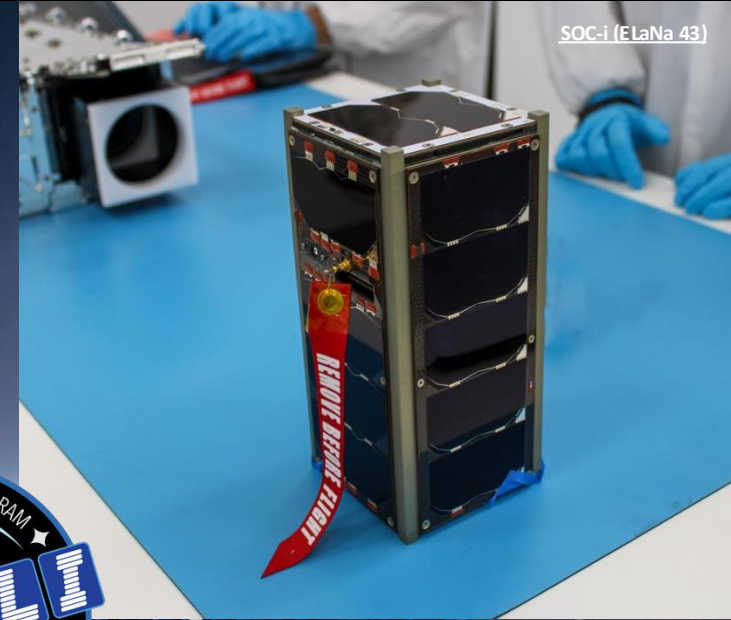
HyTI Instrument (ELaNa 51)

CURIE (ELaNa 48)
Credit: ExoLaunch

How to join CSLI through the AoPO…

Develop your Idea/Experiment

1 With the assistance of a faculty advisor, professor and/or mentor, develop a scientific experiment/demonstration that is in line with NASA's strategic goals and objectives

Build Your Team

2 If you are an educational institution, your team must be composed of students and be student run and student led. Faculty member(s) and professional mentor(s) are to serve as advisors. Clearly define all roles and responsibilities and maintain redundancy for all roles

Secure Funding

3 Secure all funding required for your mission. CSLI submittals must show evidence that all funding is secured prior to submittal

Merit/Feasibility Reviews

4 Conduct a *structured* (if possible competitive) merit and feasibility review, with independent reviewers not affiliated with your project. List the names and qualifications of all your reviewers, record action items and how you addressed each one.

Apply!

Announcement of Partnership Opportunity (AOPO) is released around the first week of August every Year. Applications are due around Thanksgiving.
Follow all Directions in the Application!

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CSLI Eligibility in the AoPO

The CSLI Announcement of Partnership Opportunity is divided into two Appendices

A

Educational Institutions and Non-Profits

Eligibility under Appendix A is limited to U.S. Accredited Educational Organizations and U.S. Non-Profits. Entire project must be led, built and managed by students, with designated student project managers. Faculty member(s) and professional mentor(s) are to serve as advisors.

B

Internal NASA Projects

Eligibility limited to NASA Centers and/or JPL for the purpose of early career workforce development. One or more team mentor(s) consisting of senior NASA employee(s) is encouraged to promote knowledge transfer

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Summary of Major 2024 AoPO Changes

Previous Years	→	2024 AoPO
If CubeSat project withdrew or defaulted from CSLI, they would reimburse NASA for costs incurred.		CubeSat projects not expected to reimburse NASA for costs incurred. NASA mitigates risk by evaluating readiness of the CubeSat project prior to incurring costs.
$300k limit on NASA's contribution to integration and launch costs. Excess were to be funded by CubeSat project.		$300k limit removed* and replaced with CubeSat size and orbit constraints to limit costs • 6U size limit • Must be compatible with at least one of three orbit range options (see following slide) **You may request a waiver** with necessity and significant value and benefit to NASA, but waiver acceptance is not guaranteed.

* Projects that are NASA funded and/or sponsored may be asked to provide matching funding if requirements exceed the baselined budget for integration and launch.

2024 AoPO Orbital Parameter Options Summary

Must be compatible with any deployment orbit within at least one of the following options.

	1 Deployment from ISS	2 Sun-Synchronous Orbit (SSO)	3 Non-SSO Orbit
Altitude*	Approximately 400 km	≤ 650km May define a 50 km span of acceptability	≤ 650km May define a 50 km span of acceptability
Inclination	51.6 degrees	SSO ± 1 degree	44 to 136 degrees, and not within 5 degrees of SSO
Mean Local Time of the Ascending Node (MLTAN)	N/A	At least 8-hour span of acceptability	N/A
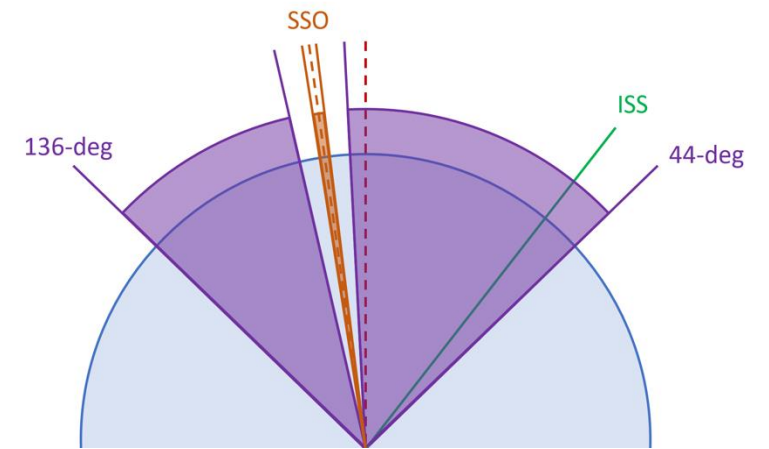
* Relevant orbital debris mitigation requirements must be met (Ex., FCC's "5-year rule" if applicable) which may reduce the acceptable altitude depending on spacecraft design.

You may request a waiver with necessity and significant value and benefit to NASA, but waiver acceptance is not guaranteed.

Mission Concepts Program (MCP)

- Partnership Program between NASA CSLI, NASA Exploration Research & Technology (ER&T), and the DoD, directly addressing challenges limiting participation

- MCP is a residential Intern Program running May through August that provides support to developing CubeSat teams at higher education institutions teaching systems engineering principles in CubeSat Design and launch

- MCP provides support and strengthens readiness of universities, teams, and faculty in preparation to propose for CSLI and DoD University Nanosatellite Program

- MCP aims to alleviate the high barriers to entry
    - Full satellite development is daunting
    - CSLI has an aggressive schedule and student turnover is a certainty
    - Effort to improve university proposals and widen the breadth and depth of submissions from underserved communities

- *Keep an eye out for next year's request for proposals!*
    - *2024 proposal cycle was open for 4 weeks in January – February 2024*

Learn more at: https://universitynanosat.org/solicitation/
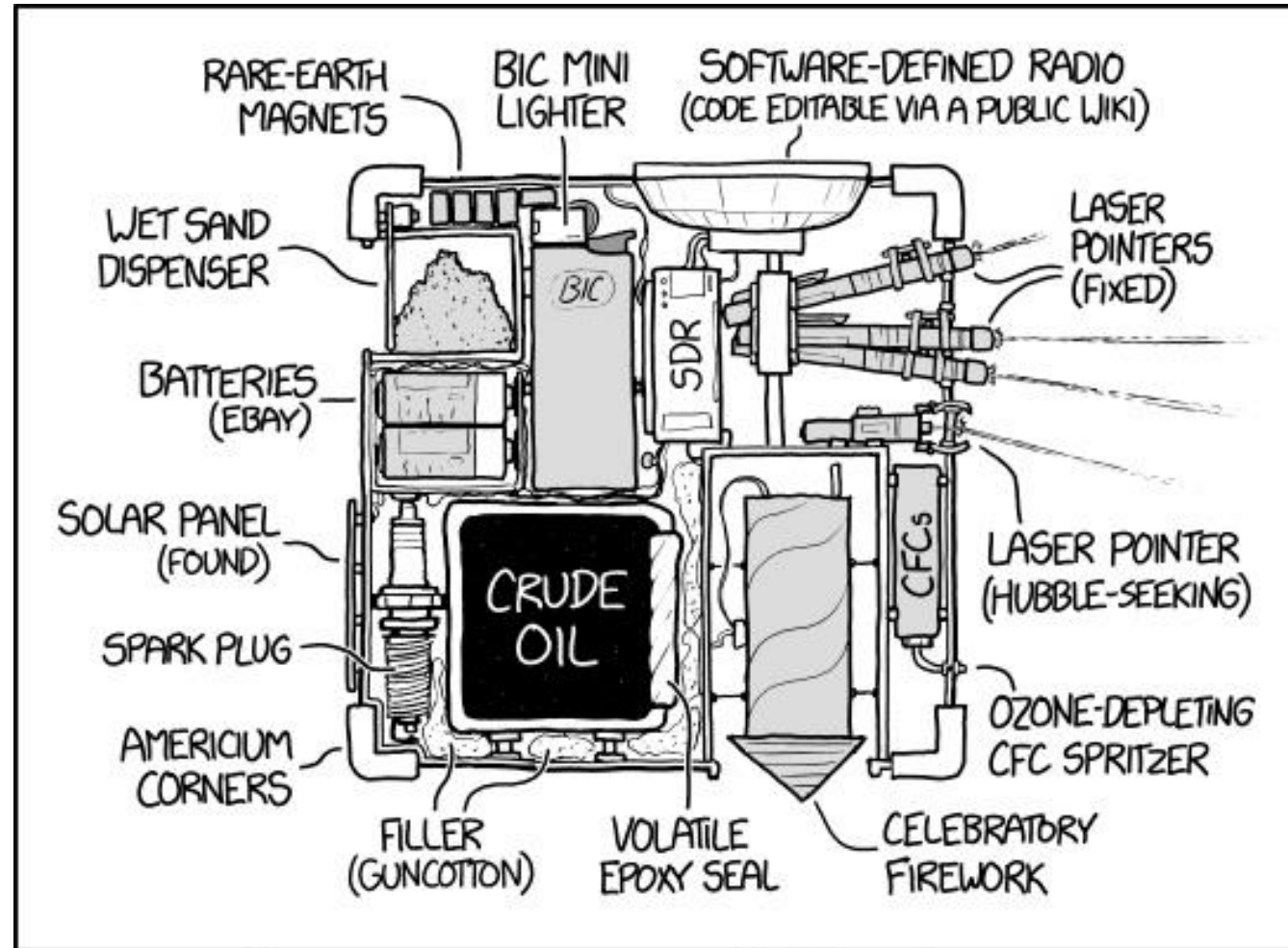
MY CUBESAT PROPOSAL WAS THE FIRST TO BE REJECTED FOR VIOLATING EVERY DESIGN AND SAFETY REQUIREMENT SIMULTANEOUSLY.

Credit: XKCD
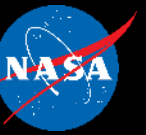https://xkcd.com/1992/
https://xkcd.com/license.html

Lessons Learned: Flexibility

- Be compatible with many dispensers
  - Comply with CubeSat Design Specification (CDS)
  - Comply with LSP-REQ 317.01 whenever possible

- Be flexible on orbit requirements, when possible
  - Unique orbits drive costs & reduce launch opportunities
  - Avoid overly congested orbits

- Design for orbital lifetime compliance (ex., FCC's 5-year rule)
  - Rideshare opportunities to low orbits may not be available
  - Consider flexibility to increase cross-sectional area (ex., deployable panels) to decrease orbital lifetime

- If your SC can affect its orbit (ex., propulsion system or drag device)
  - Use GPS and reflectors to assist in tracking
  - Consider cybersecurity

- Design to passivate your SC at end of mission (ex., deplete batteries, disconnect solar panels, vent stored pressure)
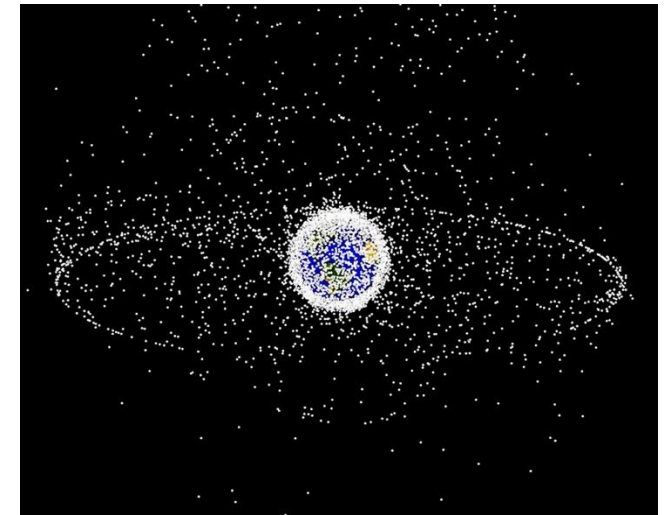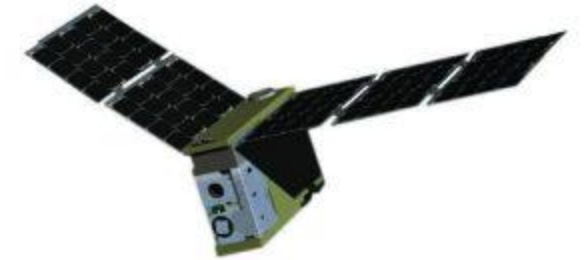
Licensing Lessons Learned

- **Start early and be persistent!**

- **We cannot integrate your spacecraft for launch without all applicable licenses. This can cause you to miss your launch!**

- Plan which licenses you will need (IARU, NTIA, NOAA, FCC)

- Be able to disconnect your transmitter via ground command

- Be flexible in case your preferred frequency/band is not available to you

- Prepare your ground station (and backup) to be operational and tested well before launch. Practice tracking/listening to existing spacecraft.

- Be sure to understand and comply with the terms of all licenses (ex., reporting requirements for NOAA remote sensing license)

Image Credit: NASA/JPL-Caltech

... persistence ...

- Create a succession plan for when team members leave, graduate, etc.

- Choose a UNIQUE name for your CubeSat and BE CONSISTENT! Avoid names that are a single common word ("Chart," "Press," "Hello 5"). Avoid special ch@r@cter$, exponents, subscripts, emojis, etc.

- Communicate with LSP about any hazardous materials or "provocative features"

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News about how to apply through the AoPO will be posted here

https://www.nasa.gov/kennedy/launch-services-program/cubesat-launch-initiative/