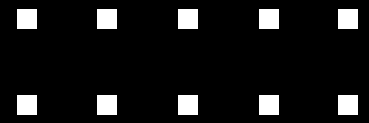
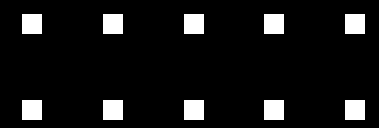
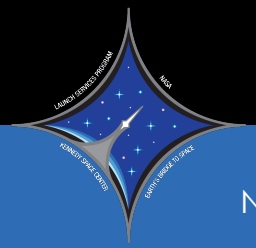


NASA's CubeSat Launch Initiative

Lessons Learned

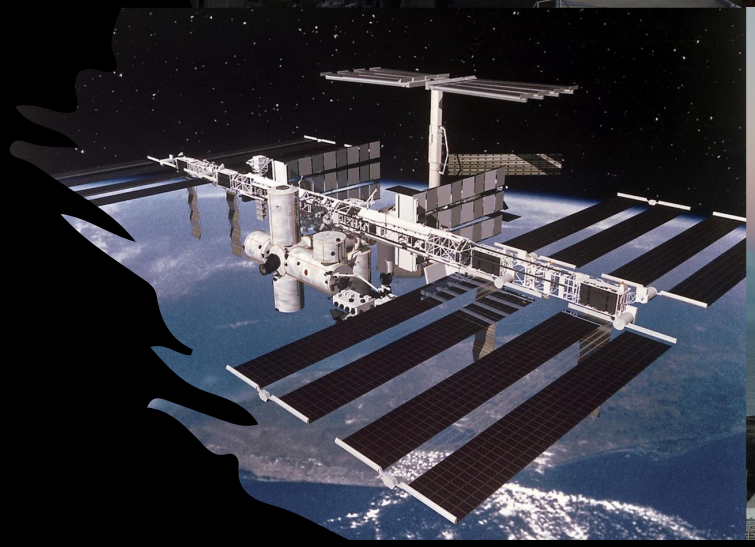
Norman Phelps & Liam Cheney





CubeSat Launch Initiative

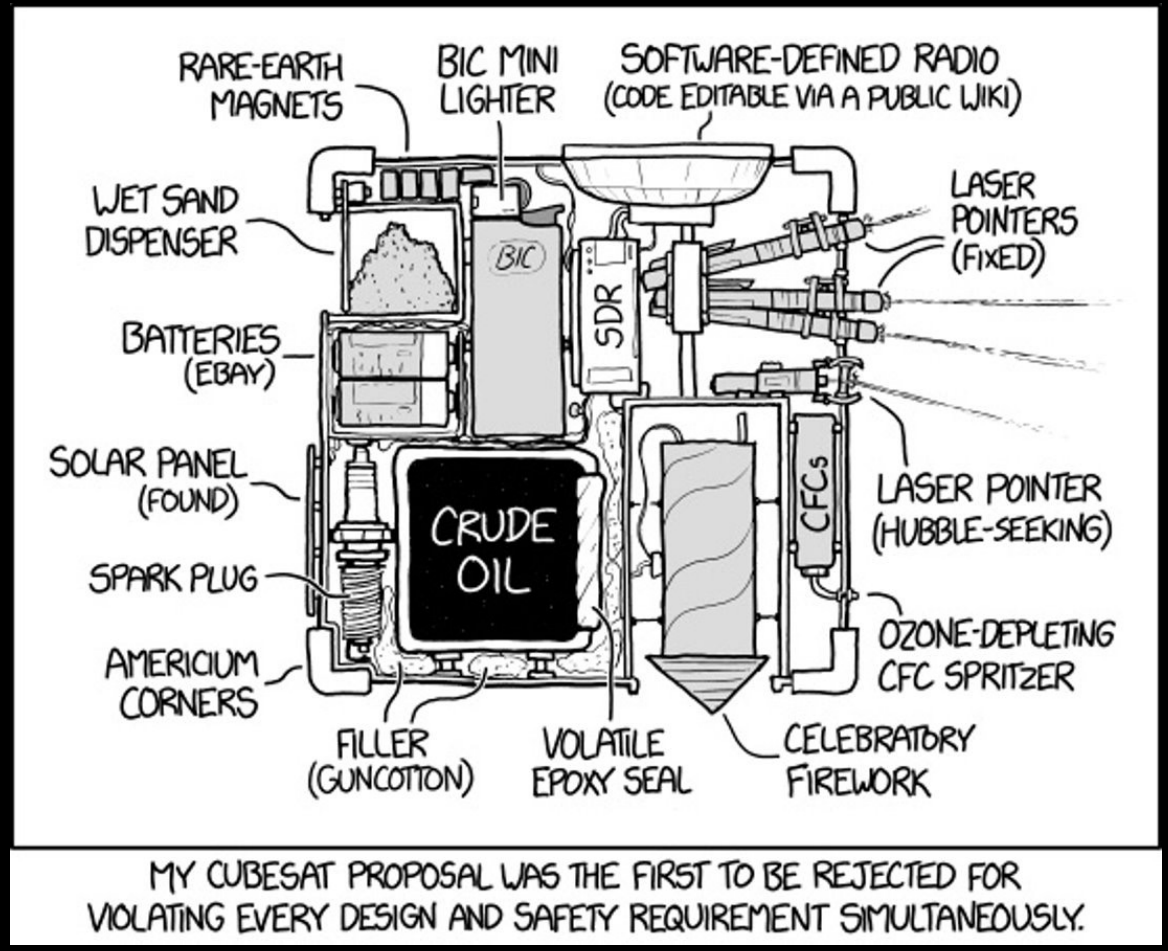
NASA's CubeSat Launch Initiative provides launch opportunities to U.S. CubeSat developers, giving them a pathway to conduct research in the areas of science, exploration, technology development and education



Accomplishments to Date

- 235+ CubeSat Projects selected from 100+ organizations from 45+ states, Washington DC and Puerto Rico
- 150+ CubeSats launched to date
- 45+ CubeSats launched in the past 24 months,
- Planned 30+ launches in the next 12 months

How not to Build a CubeSat



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

Lessons Learned

- Be Flexible to maximize manifesting options (and reduce Launch Cost)
  - Be compatible with as many dispensers as possible and avoid tabbed designs
    - Do not design to a specific CubeSat or Launch Vehicle
    - Comply with the Latest CubeSat Design Spec (CDS) and identify noncompliance's
    - Comply with LSP-REQ 317.01 whenever possible
  - Be as Flexible as possible with your Orbital Requirements but keep in mind the FCC 5 year deorbit rule
    - Unique orbits drive costs and reduce Launch opportunities (i.e if the bust is going to Pittsburgh it can't take you to Orlando)

- Design for Demise – avoid large pieces of high melting point materials, if unsure ASK

- Design to Passivate your SC at the end of your mission (ex. Deplete batteries, disconnect solar panels and vent stored pressure)

- **Choose a *UNIQUE name for your CubeSat and BE CONSITENT! Avoid names that are single common words ("Chart" "Press", "Hello 5") and avoid special characters***

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

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

- ISS battery testing is a bit of a pain- plan accordingly and talk to NASA LSP early

Licensing Tips

- 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.

Reference Documents

NASA CubeSat 101: https://www.nasa.gov/sites/default/files/atoms/files/nasa_csli_CubeSat_101_508.pdf
NASA Spacecraft Conjunction Assessment and Best Practices Handbook: NASA Releases Best Practices Handbook to Help Improve Space Safety | NASA
NASA CSLI: https://www.nasa.gov/directorates/heo/home/CubeSats_initiative
NASA Small Spacecraft Virtual Institute: https://www.nasa.gov/smallsat-institute
CubeSat.org: https://www.CubeSat.org/
Space-track.org: https://www.space-track.org/auth/login
NOAA Remote Sensing Licensing: https://www.nesdis.noaa.gov/CRSRA/generalApplication.html
IARU: https://www.iaru.org/on-the-air/satellites/
FCC Experimental Licensing System Search: https://apps.fcc.gov/oetcf/els/reports/GenericSearch.cfm
FCC Generic License Search: https://wireless2.fcc.gov/UlsApp/UlsSearch/searchLicense.jsp
Sarah Rogers Collection: http://phxCubeSat.asu.edu/resources/documents

GSFC-STD-7000 (GEVS)
GSFC-HDBK-8007
FCC DA: 13-445
NASA/SP-2007-6105
NASA/SP-20205011318
SMC-S-016
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TOR-2016-02946
NASA-STD-8719.14
LSP-REQ-317B

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Questions?