

Expanding CubeSat Development in High Schools

CubeSat Developers Workshop

April 25, 2019

LUMINARY LABS

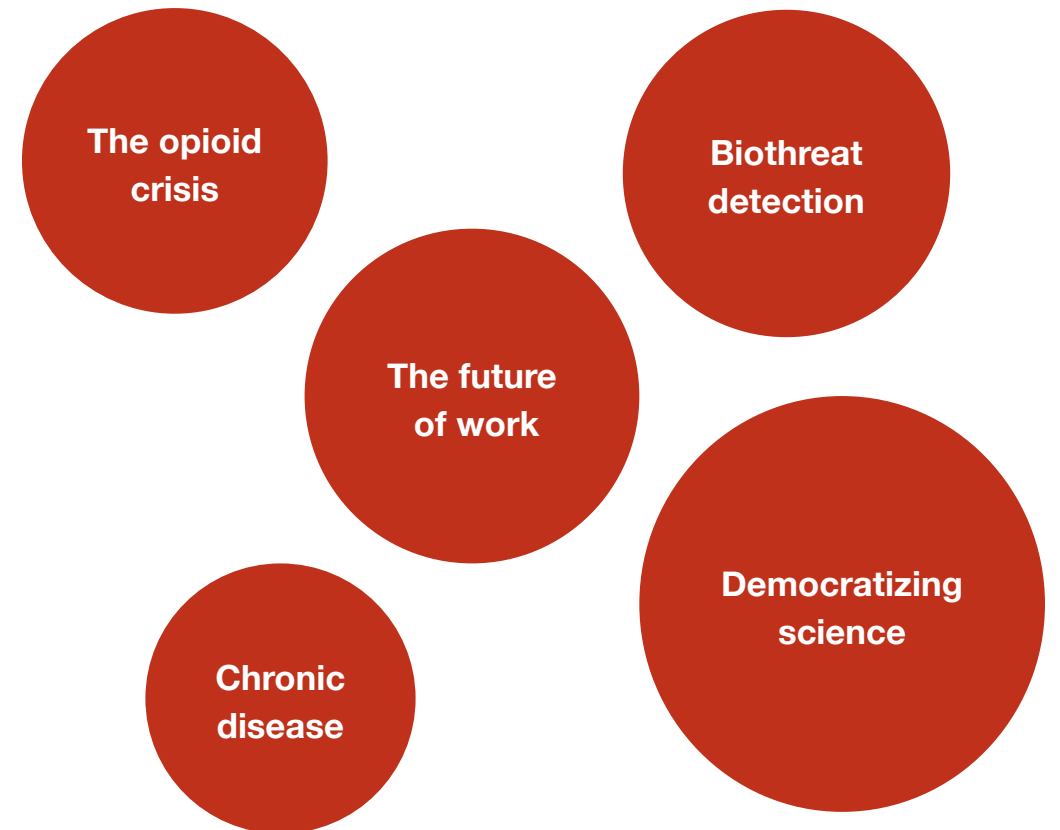
The future of space

The future of education

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Luminary Labs is a strategy
and innovation consultancy
based in New York City.



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Problem Spotlight: Building a thoughtful space economy

BUSINESS STRATEGY | ETHICS



The global space economy is currently valued at about \$350 billion and is estimated to reach \$1 trillion or more by 2040. Insiders say the "revolution that is commercial space is just beginning," and investors are taking notice. Morgan Stanley held its first space summit late last year, and said 2019 could be "the year for space."

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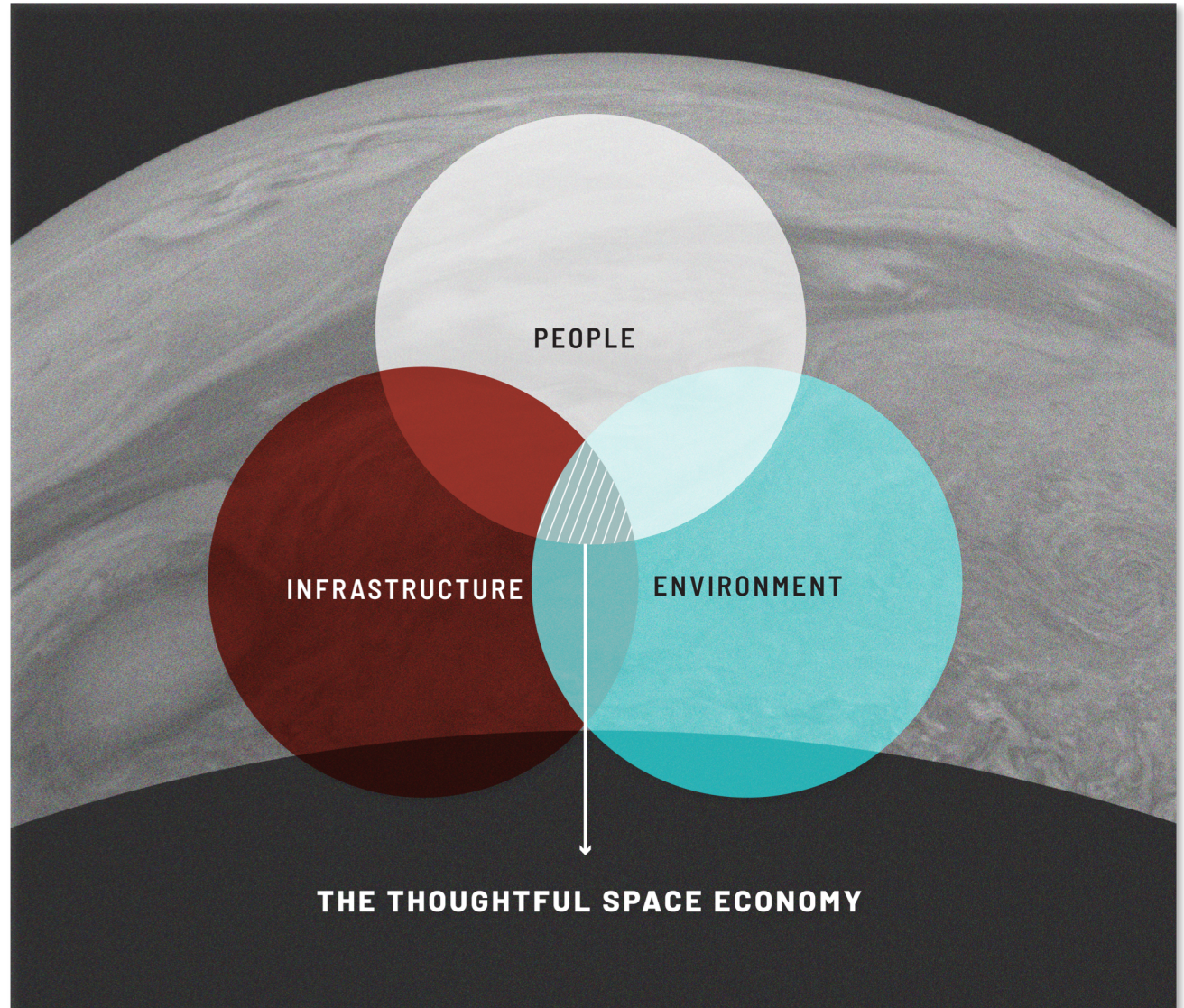


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Space is widely seen as a new frontier for exploration, but we've gone through periods of exploration before. Past ages of exploration created opportunities for some, but certainly not all; those laying the groundwork for near-term infrastructure and rewards didn't always consider long-term growth or consequences. How can we avoid the mistakes of the past and make the space economy more equitable and sustainable?



Our work with the U.S. Dept. of Education

Since 2014, we've been exploring ways to strengthen global competitiveness of the American workforce through innovation in education.

EdPrizes | www.EdPrizes.com



Reach Higher Career App Challenge

October 2015 – August 2016



EdSim Challenge

November 2016 – October 2017



CTE Makeover Challenge

March 2016 – October 2016

In 2016, 13 STEM jobs were posted online for each unemployed worker.

— New American Economy, 2017.

**You cannot learn STEM with
just pencils and worksheets.
You've got to build.**

— High School Administrator

Why explore CubeSats?

CubeSats are a platform to inspire broad exploration

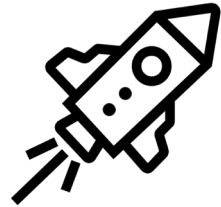
- Hands-on STEM, with direct exposure to industry-standard tools and practices
- Scientific investigation, creativity, and teamwork
- A first-hand look at careers in aerospace, technology, and beyond



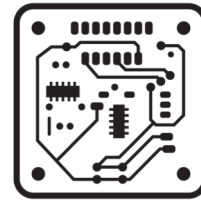
We gathered 70+ perspectives



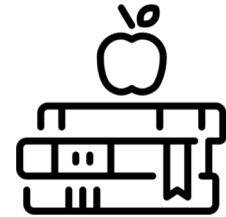
Federal
Agencies



Aerospace



Technology and
Manufacturing



Education and
Academia

What we heard

CubeSats are continuing to get simpler, cheaper, and faster to build.

They can be an effective tool to broaden STEM participation amongst underrepresented groups...

But they're still complex, expensive, and lengthy undertakings for the average high school.

Questions we have


What is necessary vs. unnecessary **complexity** for the build process?
For the regulatory process?

What **costs** are most unavoidable, and what costs might flex or change in coming years?

Can the **timeline** be streamlined or divided to mitigate turnover each school year?

Early lessons learned



A white background with abstract red shapes: a curved shape in the top-left corner and a vertical rectangular shape on the left side.

**The learning journey
can be just as
inspiring as a launch**

The learning journey can be just as inspiring as a launch

Student CubeSat failure rates are high, but not the only measure of value

Mission success rates average 45% and 77% between academia and industry, respectively. (NASA)

But ultimately “even if you can only do something sub-orbital, **it’s all still valuable experience for a student.**”

- *Aerospace industry leader*

CubeSats can still inspire students without launching

Even if students can’t launch a CubeSat, **there are many ways to “off-ramp”** and keep learning with CubeSats, such as:

- High-altitude balloon launches
- Ground stations, data sharing and experimentation

And it’s important to remember, training is the goal

“Stick to the educational mission of training. Don’t get off **course** by focusing too much on unnecessarily complex R&D or scientific experimentation.”

- *High school CubeSat program leader*



**Don't underestimate
student leadership**

Don't underestimate student leadership

Facilitation doesn't require teachers to develop complete mastery of content

“We should dispel the notion that the teacher needs to be a master of the content in order to facilitate learning. Making students more responsible for the research pushes them from passive to active learning, and is a more scalable approach.”

- High school teacher

In fact, students often benefit from increased ownership

“My students loved having a stake in the project scoping and optimization process. Saying ‘this is the idea, let’s figure out how to make it affordable and achievable’ was very exciting for them.”

- High school teacher

But CubeSats can't be 100% student-led

“It doesn't matter how much money you give a school — without a dedicated teacher leading [a CubeSat program], it won't go anywhere.”

- High school teacher



**Equity means
considering access for
students *and* teachers**

Equity means considering access for students *and* teachers

After-school programs enable logistical and interdisciplinary flexibility

Most pioneering high school CubeSat programs have used **flexible extracurricular models**, which allow:

- optimize logistics
- enable inter-grade collaboration
- cover cross-disciplinary subjects

But after-school programs are not an option for all students or teachers

After-school limits access and inclusion to those who are able to stay after hours, and after-school programs also have uncertain funding and access to facilities. that can place a larger burden on teachers and students.

Integrating into curriculum improves accessibility, but will require creativity

Offering credits connected to curriculum or electives could help:

- teachers meet **professional development goals** (e.g., Next Generation Science Standards)
- students meet **graduation goals**

But the **interdisciplinary range of skills** covered do not fit neatly into one subject or curriculum.

3 early lessons learned

1

The learning journey can be just as inspiring as a launch

2

Don't underestimate student leadership

3

Equity means considering access for students *and* teachers

**What advice do you have?
What would you like to see?**

We want to hear from you:
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Thank you

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