

September 2019

GEORGIA PATHWAYS

M A G A Z I N E



Swimming In a Sea of STEAM Part 3

Investigating **FIRE** Prevention

The Space Elevator
Things are looking up

Project Based Learning



TAG

Technology Association
of Georgia



TAG

TAG-Ed
Education Collaborative



Use Georgia Pathways™ STEM Magazine in class. Use the Smartboard. Share the link school wide, city wide.....state wide.

Each issue is appropriate for all grades and all teachers in all subjects.

Curiosity and learning are ageless.

Please enjoy this issue. You have unlimited distribution in Georgia.

Welcome to our latest edition of Georgia Pathways™ STEM Magazine.



Across the country, and right here in Georgia, STEM education efforts are transforming our economy for the better.

Take, for example, the growth of the video gaming industry. According to the Georgia Game Developers Association, the statewide economic impact of the electronic and video game industry in Georgia exceeded \$830 million in total output in 2018. The industry also employed more than 2,000 people and more than 450 new jobs were created in that one year alone.

Recently, Georgia Gov. Brian P. Kemp announced that AEV (Atlanta Esports Ventures), a partnership between Cox Enterprises and Nevada-based Province, Inc., has chosen Atlanta as the headquarters for Atlanta Reign, a professional esports team. The Midtown Atlanta facility will create 45 new jobs and represents a \$100M investment in the growing esports ecosystem in Atlanta.

The proliferation of video game development, Esports and other related areas is ushering in new economic drivers that are increasingly important. The jobs created are high-paying ones and the fast-paced growth continues, giving rise to a new stream of job opportunities.

STEM education initiatives in schools are the backbone of this economic boom as STEM programs nurture and create the future video game developers and tech leaders of tomorrow.

Supporting schools and educators in their efforts to start and expand STEM programs is vital. Increases in government funding, the popularization of STEM and the support of universities in continuing STEM pathways beyond K-12 are brightening the picture for the economy ahead.

Each edition of this publication echoes and amplifies that support. As you read through the stories and features, I hope you will be able to draw a clear line from what you see to the ripe economic benefits ahead.

STEM works and supporting STEM gives our students a brighter pathway to future job and career opportunities that can elevate their lives and boost and sustain our economy. I hope you will learn more about the value of STEM and share this publication with your networks.

Thanks for your support!

Larry K. Williams
President
TAG-Ed

Larry K. Williams serves as the President and CEO of the Technology Association of Georgia (TAG) and President of the TAG Education Collaborative (TAG-Ed). TAG-Ed's mission is to strengthen Georgia's future workforce by providing students with relevant, hands-on STEM learning opportunities by connecting Technology Association of Georgia (TAG) resources with leading STEM education initiatives.

The Technology Association of Georgia Education Collaborative (TAG-Ed) strengthens the future workforce by providing students with relevant, hands-on STEM learning opportunities and connecting them to Technology Association of Georgia (TAG) resources. Formerly the TAG Foundation, TAG-Ed is a 501(C)(3) non-profit organization formed by TAG in 2002. Later, the organization's name was re-branded to TAG Education Collaborative to facilitate our role as the leaders for K-12 STEM education in Georgia.

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From the Executive Director

Georgia Pathways™ STEM Magazine reflects the acknowledgement and celebrations of everything that is exciting about Science, Technology, Engineering and Math (STEM). Since its [the STEM acronym] introduction in 1999 we've come to understand the growth and power and STEM opportunities. And thus the continuous need to share and to celebrate what's possible via a STEM education with our students. We know that for the past decade STEM career pathways and opportunities have grown at least three times faster than non-STEM careers and they represent over 80% of the current jobs. But how are we spreading the word? How are sharing and ensuring that all students are aware, have access and have exposure to STEM pathways? And are we sharing the amazing diversity that exists in STEM so all students can see a reflection of themselves in STEM opportunities.

Well as we continue to acknowledge what's amazing, what's exciting and the innovation that awaits in STEM, let us simultaneously celebrate the amazing contributions of Latinx role models in STEM – especially during Hispanic Heritage month. Please allow us to share some of the inspiring individuals that have positively impacted science, technology, engineering and math over the past few years.

In an article written by Cammy Harbison, she shares profiles of phenomenal STEM leaders and trailblazers who are Nobel Prize winning Chemists and Neuroscientists, the first Hispanic female astronaut, a co-inventor of the X-ray reflection microscope and have been identified as some of the most influential Hispanics in the United States.

Collectively our heritage in STEM in the United States has tremendous depth and breadth. And with equitable access, the only limitations for our students are their own imaginations. One of our articles in this month's issue on project based learning is a powerful reflection of how we have the opportunity to open and expand the minds of our students through real experiences. While another article about the Space Elevator depicts how dreams become reality!

Every month we're EXCITED to share our history, our lineage what's possible in the world of STEM and the impact that you're making on the world as educators and students. Or as Steve Jobs would say, sharing how you're making your "dent in the universe". We thank you for joining us on this journey!

Sincerely,

Errika Moore
Executive Director
TAG Education Collaborative

SWIMMING in a Sea of STEAM

How to choose the right STEM product or service to meet your needs (Part 3)

By Scott Davidson

In our first two installments, we discussed the importance of aligning products and services to your goals for STEM, and ensuring that STEM products and services are developed with effective STEM integration in mind. In this final part of the series, we will take a look at how your school can maximize and add value to investments in STEM products and services.

Invest in Partnership Capital

Ideally your STEM vendors should also be part of your partnership strategy. Establishing a relationship with vendors that extends beyond the exchange of money for goods or services requires investing additional time. Though time is your most precious commodity, you will most likely see high return on the time invested if you are working with a quality provider.

First, I would ask you to consider all vendor interactions as partnership investments. Like any investment, there is an element of risk involved.

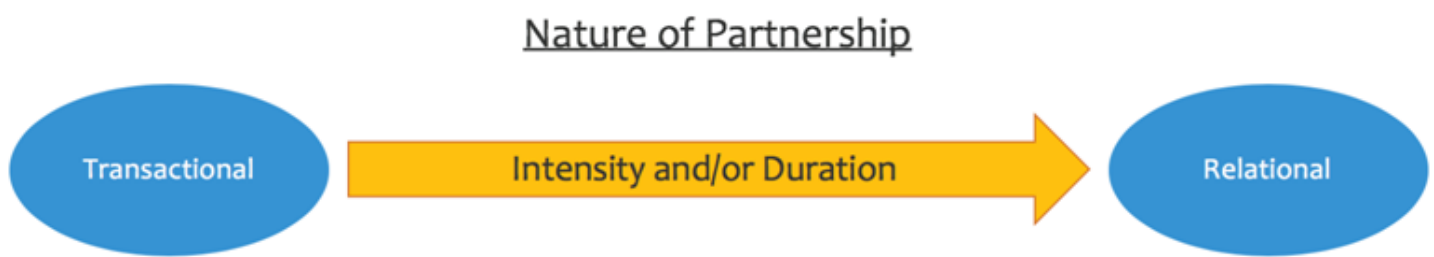
Early interactions with STEM vendors will help to determine which ones are as equally invested in your success as they are in the sale. The kind and quality of partnership is based on the longevity of the business relationship, as well as the amount of exposure that a vendor or provider has to your school.

Almost every successful salesperson that I have interacted with in an educational setting has been motivated to help their customers succeed. While the product or service offered should align to your goals, the best quality vendors can represent additional value to your organization.

Active sales teams and representatives are in schools and districts all the time, build extensive educator networks, and represent a (sort of) objective perspective on the things happening in your school. Be sure to clearly communicate your STEM vision and goals to vendors so that they better understand how their product or service fits into the big picture.



Over time, it is preferable to move as many of your partnerships as possible from a transactional to relational level of engagement:



Turn Your School into a STEM Connector

A salesperson or representative who views herself as a partner in your school is much more likely to work with you to craft better solutions. As the relationship matures over time, this could include price discounts, alternative bundling for solutions, and “free” services, such as professional development, with product purchase.

In situations where STEM vendors are introducing new products or working to field test solutions, your relationship with representatives might allow your school to take on the role of early adopter in the process. The company may also be more open to feedback and ideas from your team about new resources or supports to supplement their existing products.

Putting vendors in position to extend their own networks can also be a suc-

cessful strategy. If you are not currently hosting meetings to bring your STEM partners together, consider introducing a quarterly meeting to allow all of your STEM partners to meet and network.

The synergy created from the sharing of perspectives and expertise can bring out new ideas and ways of thinking about partnership projects already underway. This includes your implementation of STEM products and services, as well as your relationships with other community organizations. This might also help your vendor partners to extend their own professional network, which is usually part of their overall market strategy. This two-way flow of benefits is one of the

You can also ask your vendor about other schools and systems that they partner with. If possible, take the opportunity to visit other schools using similar products or solutions. *Invite other schools to see what you are doing* with a particular STEM product.

Again, there are multiple benefits associated with this strategy. In addition to the exchange of ideas related to a particular STEM product or service, this will allow peers to observe and discuss all kinds of program-related features in place in schools. This will also help to polish your school's approach to hosting observers, which could promote your site as a demonstration school. This status can increase the likelihood of your school gaining early access to new products and services.

Finally, connecting with other schools might bring to light opportunities for cost or product sharing opportunities with a specific vendor. Combining dollars to offset the costs of training, PD, and/or product can end up saving your school substantial amounts of money.

If you are part of a large system implementation, such as a specific tech device or STEM program, make sure that your school is well-known (in a positive way) to the sales representative. Assign a staff member, like your STEM Coordinator or Media Specialist, to interface with the vendor contact and lead the implementation at your site.

Be sure to communicate your school's interest and excitement in implementing the new product, and develop a strategy for collecting data and information as the implementation progresses. In a large system with potentially hundreds or thousands of users, a school that is proactive, positive, and strategic is much more likely to receive support and attention from vendors.

Furthermore, proactive leadership from your school is likely to result in additional opportunities for pilot programs and flexibility from your own district.

Ultimately, your partnership goals are focused on improving STEM learning experiences for your students. Working to build relationships with vendors will help you to better separate those that are truly invested in your success from those who are purely interested in the business transaction. Quality STEM vendors will want to be seen as partners in your school, and reciprocating this interest will most likely lead to unanticipated, positive benefits for your staff and students as your business relationships mature over time.

Wrapping Up

We hope that you have found this 3-part look at maximizing your STEM investments helpful. At the core of these articles are the elements that define quality STEM implementation in schools and systems.



This is an important part of Cognia's work in providing standards of practice for STEM schools as well as STEM providers. To learn more about our processes for recognizing STEM schools and vendors through certification, please email me any time. Also feel free to contact us if you have questions or if you are in need of support in your STEM journey.

Scott Davidson is the Senior Director for STEM Services at Cognia (formerly AdvancED/Measured Progress). His team provides support and thought leadership for PK-12 STEM education across Cognia's network of over 36,000 institutions in more than 80 countries. You can reach Scott via email at scott.davidson@cognia.org.





Investigating Fire as Fire Prevention:

How One STEM Resource Promotes Fire Safety Through Interactive Learning

By Dr. Kelly Keena

The fire safety community continually aims to reduce fire injuries and deaths. Fire Prevention Week, which is observed annually in the United States and Canada during the week of October 9, is one week out of the year when the effort gets amplified. This campaign was launched by the National Fire Prevention Association (NFPA) and became a national observance in 1925 to educate the public about deterring fires.

And now fire safety is more important than ever. Forty years ago, people had 17 minutes to escape their home in the event of a fire. Today, fire is faster due to synthetic fabrics in furniture, lighter construction materials and open floor plans, leaving people with three minutes or less to escape.

This year's Fire Prevention Week theme is "Not Every Hero Wears a Cape," which refers to incredible fire service professionals and the heroic actions civilians can take every day.

One of these daily heroic actions is education. Sean Grey, Fire Captain in Cobb County, Georgia, emphasizes an understanding of fire science as a tactic to avoid human-caused fires. Gray is part of a unique collaboration between Cobb



Dr. Kelly Keena

County Schools, Cobb County Fire and Emergency Services and global safety science organization Underwriters Laboratories (UL) Education and Outreach team.

Middle school educators train alongside firefighters and investigators on the UL Xplorlabs Fire Forensics education resource, an online educational platform designed to encourage students to solve through science. It is especially focused on engaging middle-school students during a time in their educational lives when interest in science is shown to decrease dramatically.

The module was developed with the UL Firefighter Safety Research Institute

(FSRI), an applied research organization that advances knowledge of fire dynamics and develops cutting edge, practical fire service education aimed at helping firefighters stay safe while more effectively protecting people and property. Working in partnership with the fire service, research departments, and agencies, UL FSRI executes firefighter research and makes the results widely available to the global fire community. The Fire Forensics module content is based on UL FSRI's research exploring the effects of open and closed doors on ventilation and fire behavior.

In UL Xplorlabs Fire Forensics, students become fire training cadets and explore the science of fire and concepts such as pyrolysis, the chemical reaction where heat breaks down solids into fuel gases which mix with oxygen in the air to ignite in the chemical reaction we know as fire. They then use that acquired knowledge to solve a burn scene; students investigate the source and the cause of the fire. Using the Claims, Evidence, and Reasoning (CER) framework, students must use evidence they collect in the burned kitchen to support how they solved the case. The module fortifies STEM educational concepts based on students' acquired knowledge and understanding of fire science.

The partnership between Cobb County Schools, Cobb Fire and UL extends to teachers' classrooms; when the students do the hands-on investigations with candles and open flames, fire fighters co-teach the lessons with the teachers.

The partnership has the added benefit of introducing students to various vocational opportunities. The firefighters' role in this partnership is twofold – they serve as content experts working with the students on the experiments, and they also share various STEM career paths in the fire service field with the students. In working with these experts, the program supports student investigations that drive engagement and offer access to potential careers.

This approach helps create relevant and meaningful experiences in STEM and provides students with some of the faces and voices behind the work in various fields. In doing so, students can learn critical skills and problem-solving for all occupations and learn how their passion can lead to careers that address the world's safety challenges.

In addition to the Cobb County partnership, Xplorlabs' Fire Forensics module has also been incorporated in Camp Fury Delaware and the Kids Summer Fire Academy camp in Apopka, Florida.

Camp Fury Delaware is a female-led summer camp at the Delaware State Fire School designed to introduce young women between 13 and 17 years old to the emergency services field. 60 girls who attend the camp spend their days preparing to fight fires and protect their communities. Elizabeth Schew, Assistant Chief fire Marshal of Chester County Pennsylvania Department of Emergency Services, is one of the camp counselors

and has adapted the classroom program to her campers' needs to teach the girls about fire behavior. Specifically, she uses the resource to highlight the fire triangle – a model for understanding the necessary ingredients for most fires and how to extinguish fires by eliminating certain components.

The module also has been used effectively at the Kids Summer Fire Academy camp in Apopka, Florida. Here, students in elementary, middle and high school experience hands-on activities and exercises designed to take them up close and personal into the world of fire safety and science through one- and two-week courses. Jerry Maynard, the Apopka County Fire Department's public educator, uses the fire forensics resource to demonstrate real-life applications of the fire triangle and tie learnings to his demonstrations.

UL Xplorlabs Fire Forensics uses a framework of safety science to bolster STEM curriculum. Because of its structure, teachers have significant flexibility in how and when they implement the program. While fire safety is always relevant, these qualities make the program especially pertinent during Fire Prevention Week.

Dr. Kelly Keena is the director of education and outreach for Underwriters Laboratories.





Want to



Go to Mars? Be Prepared to Exercise Several Times a Day



by Irissa Machetta

It sounds like something out of a science fiction movie: identical twins subjected to an extraterrestrial experiment. At the National Aeronautics and Space Administration (NASA), where the line between science and fiction often blur, astronauts and identical twins Scott and Mark Kelly participated in a year-long gravity study.

Scott spent a year in space while Mark stayed on Earth. Scott went into space as a carbon copy of Mark, but when he returned from the International Space Station (ISS), he was no longer the same.



While his twin brother circled hundreds of miles overhead, Mark, as the control study on Earth, fought the immense force that all earthlings fight every day just by walking or climbing or getting out of bed. It's a fundamental force that space lacks, but that helps keep earthlings naturally fit: gravity. While in space, Scott's body had no need to contract muscles to perform basic functions. Instead, he floated. Although it might sound too good to be true—floating out of bed in the morning rather than struggling to kick off the sheets and get up—Scott's muscles deteriorated.

As Dr. John Dewitt, a Biomechanics expert at NASA's Johnson Space Center (JSC), explains, "The normal forces that we experience in daily living are not apparent. So, our muscles and our bones respond by simply saying, 'Hey, I don't have to work against anything, so I don't have to stay strong.' As a result, the muscles and the bones get weaker, and they start to get smaller. In order to combat that,

we must apply force, and the basic way to apply force is through exercise."

Exercise at the ISS targets specific muscles called anti-gravity muscles. To stimulate these vital muscles, astronauts on the ISS use three devices: A treadmill, a bicycle, and an Advanced Resistive Exercise Device (ARED)—a weightlifting machine. Space requires unique designs for each machine.

For example, the ISS treadmill contains a harness and bungee cords for the astronauts to strap into, so they don't float away. Since traditional dumbbells would also float, the ARED machine utilizes two piston-driven vacuum cylinders that look like oversized bicycle pumps. Astronauts can increase or decrease the weight by adjusting the length of the arm.

Likewise, the bicycle is no ordinary bicycle; it has no seat since the astronauts would float off it. Instead, it is redesigned with a back pad to enable astronauts to

remain stationary. The astronauts on the ISS must exercise consistently to prevent muscle loss from occurring. As Dr. Tweedy, a countermeasures systems instructor at NASA's JSC told Verge, "Astronauts on the station work out six to seven days a week for 2.5 hours each day."

Muscle loss is not the only thing astronauts have to worry about in space. Like muscles, bones don't have to fight against gravity either, so they lose mineral density. Unlike muscles, however, where pressurized exercise machines can replicate the effects of gravity, bones need a chemical supplement called bisphosphonate.

While muscles can be rebuilt when astronauts return to Earth, once bones deteriorate, there is no way to restore them, even

with supplements. The loss of bone and muscle leads to multiple problems. As Dr. Dewitt has said, "It affects a whole host of systems."

Upon returning to Earth, astronaut Scott Kelly lamented, "Every part of my body hurts. All my joints and all of my muscles are protesting the crushing pressure of gravity." So, whether you want to travel to Mars, the Moon, or even the International Space Station, if you want to be an astronaut, there is no way to get out of exercising to stay fit.

About the author-

Irissa Machetta is a NASA 'HAS' Aerospace Scholar and the Founder of Miss STEM International, a non-profit organization dedicated to empower girls to pursue STEM studies.

As an AP National Scholar and a MOS-TEC STEM Scholar at the Massachusetts Institute of Technology (MIT), she authors and co-authors articles on aerospace- and space medicine-related subjects.



Project-based learning

helps students solve real-world problems

by J.D. Sumner

District Communications Manager / Dougherty County School System

It was a humid 87-degree September afternoon when 9th-grade student Beah Wise and her fellow students left the comfort of their school and went outside to work on their school project.

“Today, me and my fellow 9th graders are planting greens for our community,” Wise said, taking a brief break from getting her hands dirty planting broccoli seedlings in one of 30 planter boxes just outside of the Commodore Conyers College and Career (4C) Academy in Albany.

The students are planting the vegetables as part of a project-based learning program adopted by 4C Academy called “Group Up: Working for a Better Tomorrow,” which aims to address some of the city’s challenges while also providing hands-on learning for students in the school’s 14 career pathways.

The agriculture project provides an opportunity for several of the students in various career pathways towards a common objective while helping to address a food desert problem plaguing South Albany.

“We’re in South Albany in what’s known as a food desert. There are no grocery stores within a five-and-a-half-mile radius of this school so those who struggle with transportation don’t have access to fresh food,” 4C Academy CEO Chris Hatcher said. “So what we’re going to do with this food is to turn right back into this neighborhood.”



“We’ve got kids in construction, mecha-
tronics, engineering, marketing, infor-
mation technology and nursing all out
here learning about this particular project
because it has so many different elements
to it. It has a nutritional value from sci-
ence and health standpoint, our construc-
tion team is building the boxes and more.
There’s really a lot of opportunities that
touch many of our pathways.”

This project-based learning approach is
one way 4C and the Dougherty Coun-
ty School System is working to address
community challenges while providing
students with real-world, applied learning
opportunities that will help prepare them
for success at the next level.

All told, there are 10 projects that are
either in development or underway that
provide students with a broad array of
opportunities. Some of those additional
projects include a recycling project part-
nering with Keep Albany-Dougherty
Beautiful, a renewable energy project
with support from Marine Corps Logis-
tics Base Albany and a robot developed
by students that picks up trash in parking
lots after events.

These kinds of projects require a lot of co-
ordination from school staff but also sup-
port from community partners. With the
planter box project, students are working
alongside Fredando Jackson who goes
by the moniker “Farmer Fredo,” and his
company Flint River Fresh, to learn about
Georgia’s number one industry.



The soil and organic materials used to
form the planter boxes was gathered
thanks to a donation of a tractor by Flint
Ag and Turf.

It’s these partnerships that Hatcher and
the rest of the team at 4C hope to leverage
to make the projects successful as they
move forward with permanently integrat-
ing project-based learning days into the
classroom schedule at 4C.



“This will be an annual project where we dedicate Fridays to STEM project-based learning opportunities like these,” Hatcher said. “On Fridays, we have no coursework happening here at 4C; there’s no English or Math; what we’re doing is empowering our students to learn those things and skills through these projects.”



Resilience — A Sustaining Gift for Your Children

by Dr. Judy *Willis*

resilience

[ri-zil-yuh ns, -zil-ee-uh ns]

noun

- the power or ability to return to the original form, position, etc., after being bent, compressed, or stretched; elasticity.

- ability to recover readily from illness, depression, adversity, or the like; buoyancy.

Helping children become resilient builds their character & academic success.

Resilience in learning, as in life, provides the capacity to persevere through setbacks, take on challenges, and even risk making mistakes on route to reaching goal achievement. Helping your children build their resilience promotes their character, academic success, optimism to undertake new challenges, and encourages a more positive approach to life.

When guided to build their resilience, children find motivation to be effortful, optimistic about sticking with tasks when stymied, willing to request help without shame, and positively respond to constructive feedback.

Guided experiences can promote your children's resilience. This article describes techniques to help them build competence, mistake tolerance, and goal setting elements of resilience.

These are the foundations that help children sustain effort even when the challenge seems unsurmountable or mistakes are perceived and suffered as setbacks and failures.

Competence builds resilience

It is not uncommon for children to respond to repeated failures by developing low self-expectations for success. By providing confidence enhancing experiences that build their competence, self-efficacy, and mistake tolerance, you'll help unburden them from that restricting expectation of failure.



They may feel overwhelmed when perceiving a task as beyond their capabilities or, in a larger sense, suspecting they've fallen too far behind to get back on track.

A simple activity exists that can help enlighten children to recognize that they can succeed even when feeling helpless confronting these stumbling blocks. This activity can show them that some tasks, seemingly impossible or too confusing at first, can be broken down into smaller parts they can understand and act upon.

You'll need an unrepairable clock, watch, safe (not sharp and unplugged) appliance, or broken mechanical toy (e.g. talking stuffed animal, jack-in-the-box) from your home or from a thrift store. Using an age-appropriate object, ask your child how he thinks it might work.

Don't give hints, but support all and multiple guesses/predictions with a positive response. After he has offered several theories, invite him to take it apart. Make it a discovery experience without any expectation that he must come up with an answer about how it works. Let him know it is already broken and he won't need to put it back together.

The object is to build his resilience to feeling overwhelmed by letting him discover, his own abilities to evaluate complex problems or tasks by "breaking them down" into recognizable "doable" parts.

If your child needs encouragement to recognize familiar parts, you can prompt him with questions. Ask if he recognizes any simple workings such as, springs, screws, coils, wheels with teeth, gears, batteries, or wire. If so, invite him to share how the parts might work together to help make the device function.

On completion, explain, "You've just demonstrated your ability to break down something that you didn't understand into parts you did understand." What an accomplishment!

When children experience how breaking-down an object reveals parts they recognized, they can remember this when future tasks seem overwhelming (and you can remind them of the activity as needed). The experience will build their competence awareness that they can break down complicated tasks into doable parts and avoid feeling overwhelmed.

Help children do the same with planning events such as their birthday parties, picnics, camping outings, or family celebrations. They will build awareness that big tasks and school assignments can be broken into small tasks. This will build their confidence to get started and their strength to persevere. Invite your child to put her insights into a motto or posters for her room such as, "By achieving one task after another, I can get the whole job done." "Break it down, build it up," or "One step at a time will get me there!"

Failing forward

When you provide opportunities for children to encounter mistakes as an expected part of the process of learning or novel experiences, you build their resistance to setbacks and errors. Through sharing your own mistakes, encourage open discussions of their past “blunders” and guide them to recognize that mistakes are really part of learning.

For example, “If you don’t make mistakes, it means you already knew it, so you aren’t building your knowledge or skill.” The goal is for your children to develop the competence, optimism, and understanding to persevere and progress from missteps to goal-achievement.

Here are some topics to prompt discussions and build mistake resilience.

- When children make mistakes, explain that these are not failures. They are opportunities for brain building that will bridge them to future successes.

- o Regarding mistakes, help them understand that their brains have evolved to be survival tools. In this programming, the brains of mammals in the wild, adapted to make rapid decisions and choices in response to change or threat.

Our human brains still have that primitive reaction of making quick responses to new situations and even to questions on a test.

- o “Your brain is doing its survival job when it jumps to quick conclusions. But because you are not out in the wilds in danger of attack or stalking wild beasts, you can use your human ability to think before acting. Knowing your brain might jump to first responses, take few seconds to be sure your brain’s first choice is the best.”

- When your children make errors encourage them to correct them with revisions. Explain that:

- o “When you correct an error you make, your brain builds new wiring to guide you to make a better choice the next time and the next.”

- o “Your brain is programmed to rewire any faulty memories or ideas that lead it to make mistakes. It makes sense that for survival the brain would learn from miscalculations. When you take the time to think about the better choice or answer, your brain takes this correct information and wires it into the memory network to replace the faulty information.

This is why the strongest understandings to guide your best future answers and choices come from evaluating for mistakes, rethinking, correcting and revising and re-trying.”

Other opportunities are suited to build tolerance so children see mistakes as “failing forward.”

- Discuss/demonstrate common mistakes kids might make before or as your child prepares for a new skill or assignment.

- Point out your own mistakes and acknowledge how you feel (or felt) at the time/

- Invite them to share their past “whooper” mistakes and recognize they survived them and can revisit softened with the perspective of time and perhaps humor.

Personal meaning builds persistence

Relevance is a powerful tool to ignite and sustain resilience through engagement and effort. Guiding your children to find personal relevance in challenging school topics increases their interest and effort. Showing them how they could use the skill or knowledge in present understanding or future actions provides incentive to struggle on.

For example, if your children are studying the metric system, boost relevance and perseverance by inviting them to select a recipe from a cookbook you get from the library or online published in England or another country that uses the metric system. They will want to know how to make the “translations” between metric and standard measurements to make that cookie dough or play dough clay.

They will be motivated to use tools of metric conversions to achieve the personally desirable goal.

Increase personal relevance to motivate perseverance in the study of history by using examples or comparisons encompassing a controversy of current day issues that are of interest to your children in sports, school policy, or community conflicts of interests regarding city planning. Adapt their word problems in math to include your child’s name, sports heroes, or names of other people of high interest.

It’s not what they know, but what they can do with what they know, that is the most powerful wisdom for your children. By enhancing your children’s resilience through applied experiences they can progress with the understanding that success is possible, mistakes are part of learning, and knowledge builds through personally relevant tasks.

Children are more likely to remember, embrace, and apply what they learn to future applications when they connect with personal relevance, discovery, and strengthen their skill and understanding with perseverance.

Dr. Judy Willis, a board-certified neurologist who has combined her 15 years as a practicing adult and child neurologist with her teacher education training and years of classroom experience. Dr. Willis travels nationally and internationally giving presentations, workshops, and consulting while continuing to write books for parents and educators. She is an authority in the field of learning-centered brain research and classroom strategies derived from this research.

Inspiration: stimulation / arousal of the mind, feelings..



to special / unusual activity
or creativity

I was *inspired* to **experiment**.

I was *inspired* to **innovate**.

I was *inspired* to **solve a problem**.

I was *inspired* to **theorize**.

I was *inspired* to **calculate**.

I was *inspired* to **design**.

I was *inspired* to **question**.

I was *inspired* to **seek**.

I was *inspired* to **explore**.

I was *inspired* to **build**.

I was *inspired* to **teach**.

I was *inspired* to **understand STEM**.

CIVIL ENGINEER STEM EXERCISE

To the right is an intersection diagram that can be printed out and used in class.

We have a four way stop that is in need of expansion and modification to accommodate greater traffic flow. Students should modify the drawing to design a more efficient intersection. There are no limits or restrictions in your redesign.

Engineers are problem solvers. A civil engineer would be responsible for this redesign of a real local intersection.

Here are some of the problems:

- Four way stop
- Only two lanes of traffic
- Congestion
- Delays

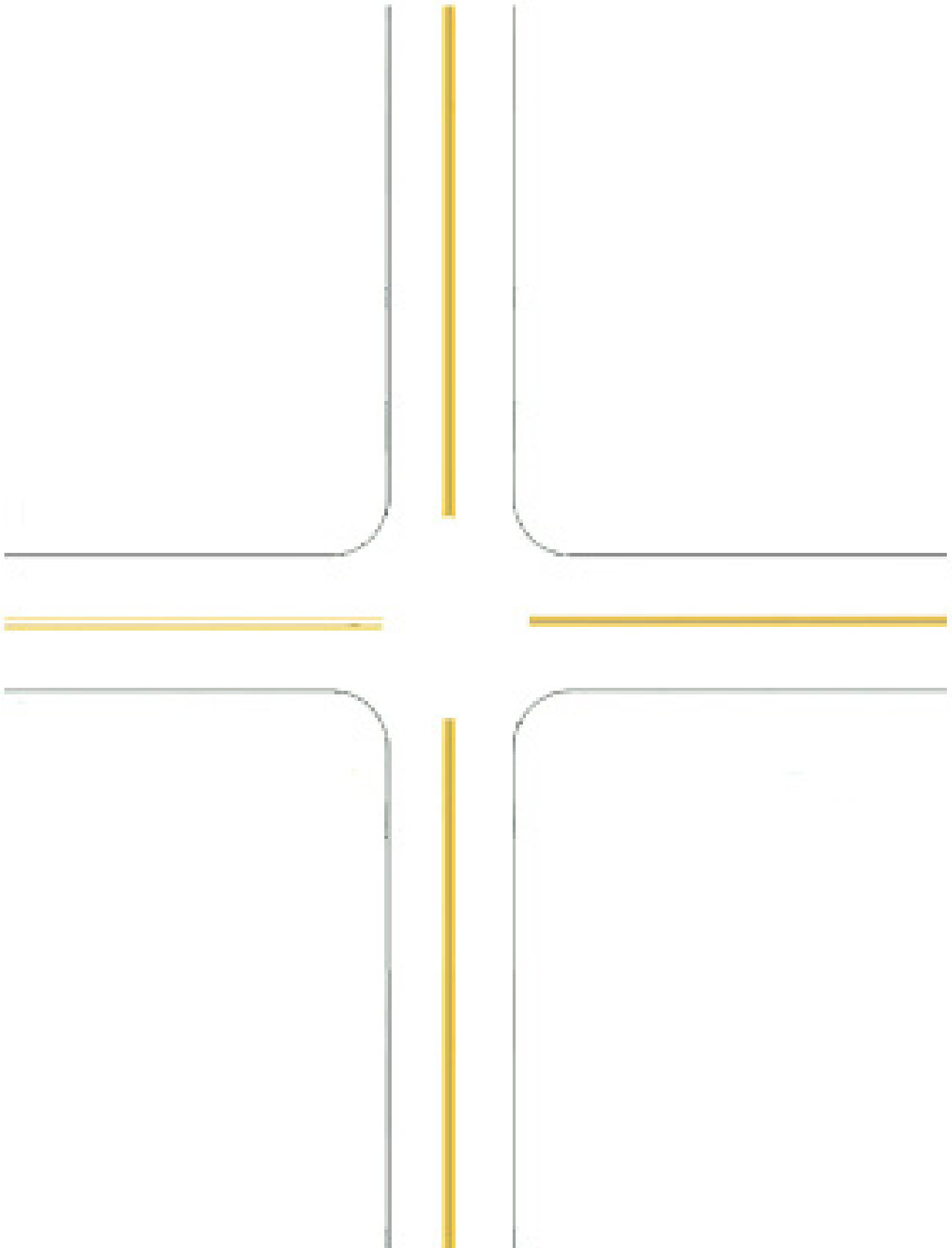
The task is a complete redesign. *No budget.*

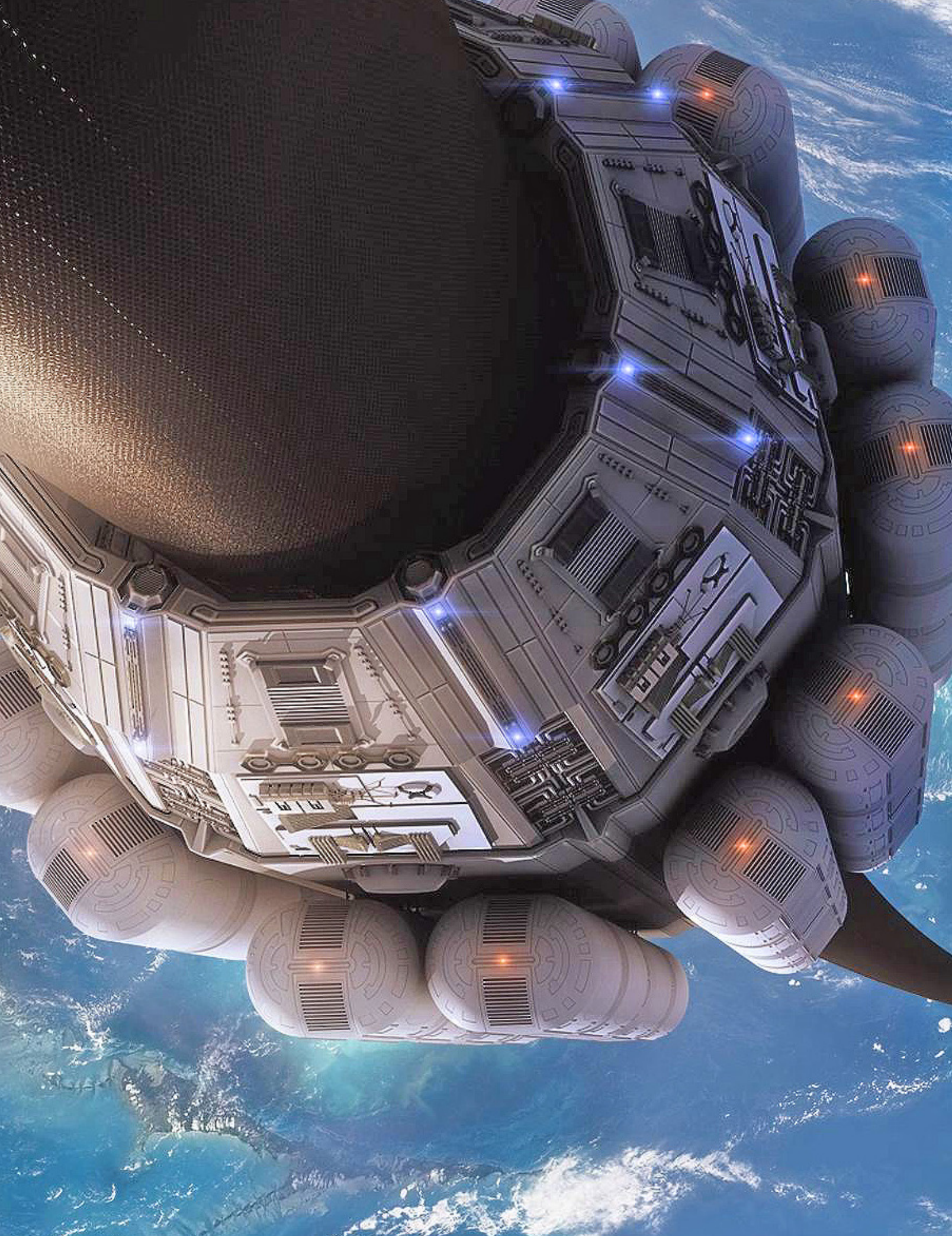
- More lanes
- Turning options
- Lighting options
- Imagination is needed
- What else might be needed?



This project can take as long as you wish, with research, development, failures, inspiration and imagination.

Make this a competition. Submit results to a local civil engineer for review and determination of the most functional designs.







Space Elevator

Science Fiction Becomes Science Fact?

*by Peter A. Swan, Ph.D.,
and Cathy W. Swan, Ph.D.*

This isn't the first time science fiction was on the verge of becoming science fact. Multiple companies and organizations are currently building or researching the reality of a space elevator.

One such group is The International Space Elevator Consortium who has chosen to describe the space elevator from the top level to help readers understand its status as of the summer of 2016.

One of the first steps is to describe the three concepts of space elevator infrastructure that are sufficiently refined to be seen as "real." To accomplish this task, the authors present their views starting with the questions:

- Why are we going to build a space elevator infrastructure?
- What is the range of missions enabled by space elevators?
- What are the three concepts for modern day space elevators?

- **Reason:**

Routine access, affordability and safer access to space.

- **How?**

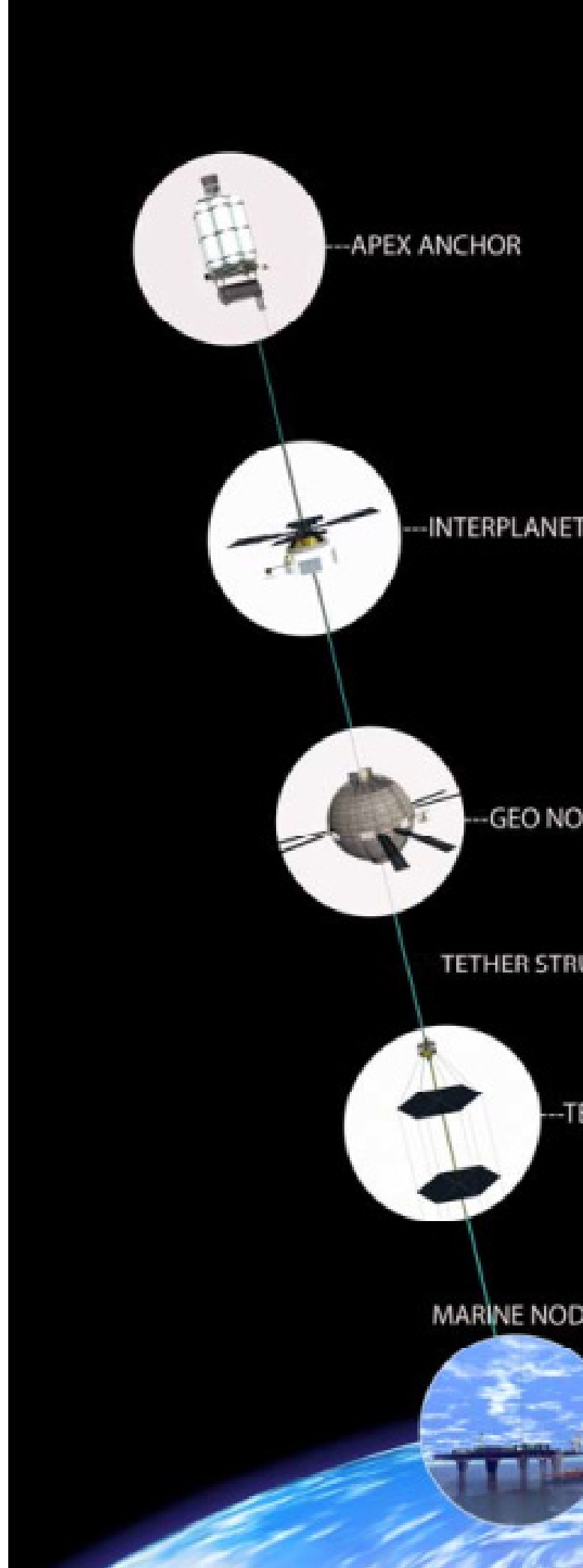
A thin ribbon, 1-meter wide, 100,000 km long, with climbers using opposing wheels pressing upon the ribbon. Driven by electricity, they rotate with friction enabling movement up the ribbon. It works!

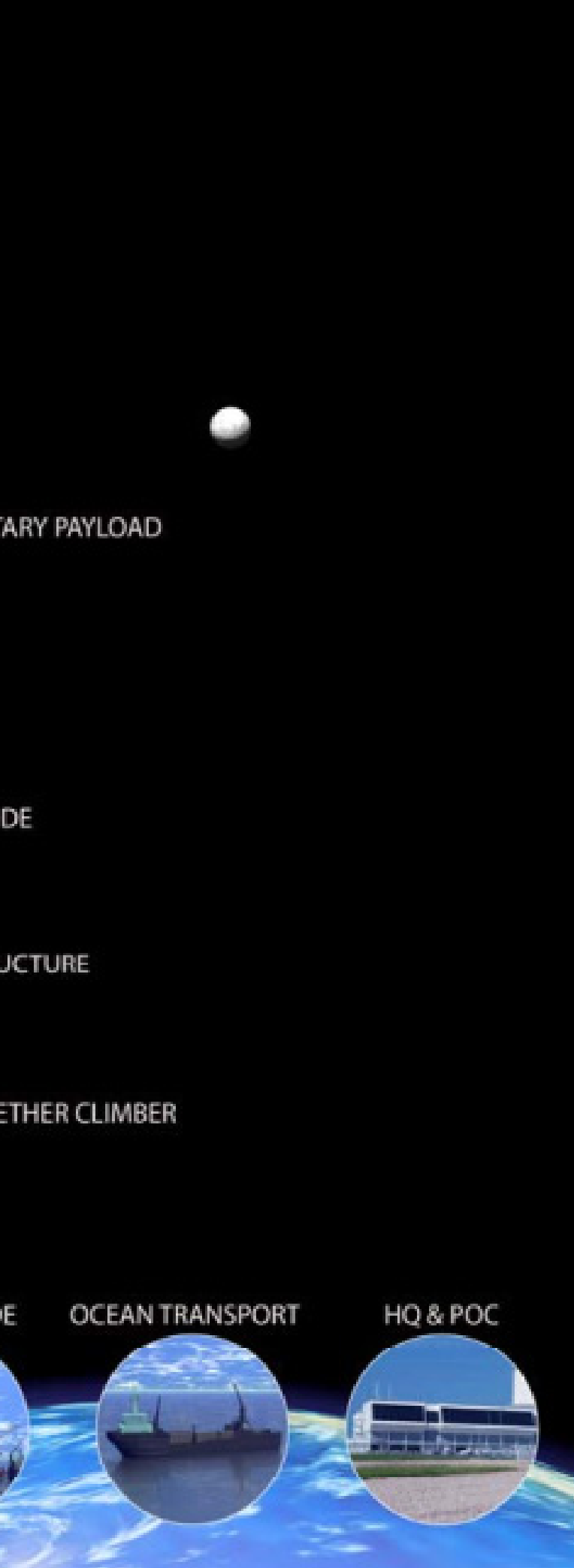
- **Why?**

Space access and solutions for Earth based problems are limited by current launch size and cost. Humanity must move off Earth and space elevators could enable that.

The Space Elevator will be a transformational transportation system. It will move objects, systems, material and eventually people from the Earth to Space. The Space Elevator will be incredibly more efficient than today's launch systems.

It will be safe. It will be environmentally friendly, and most importantly, it will enable a wide range of revolutionary activities in space. Because of a Space Elevator, we will do today's space missions better than ever before. It will enable us to do missions in space that we have only imagined. One goal is to show the space elevator community's expectations for future missions leading towards an intermediate and then future destinations.





Geostationary orbit:

A geostationary orbit, geostationary Earth orbit or geosynchronous equatorial orbit (GEO) is a circular orbit 35,786 kilometers (22,236 mi) above the Earth's equator and following the direction of the Earth's rotation.

An object in such an orbit has an orbital period equal to the Earth's rotational period and thus appears motionless, at a fixed position in the sky. Communications satellites and weather satellites are often placed in geostationary orbits, so that the satellite antennas (located on Earth) that communicate with them do not have to rotate to track them, but can be pointed permanently at the position in the sky where the satellites are located.

Using this characteristic, ocean color satellites with visible and near-infrared light sensors (e.g. the Geostationary Ocean Color Imager (GOCI)) can also be operated in geostationary orbit in order to monitor sensitive changes of ocean environments.

It's only about 60 miles to space, but you have to orbit at about 19,000 miles per hour to stay in that orbit. A GEO orbit requires you to continue out to about 22,236 miles from Earth so Earth's gravity does not pull you down....thus the ability to keep your position as the Earth rotates.

A geostationary orbit is a particular type of geosynchronous orbit, the distinction being that while an object in geosynchronous orbit returns to the same point in the sky at the same time each day, an object in geostationary orbit never leaves that position.

The space elevator concept is nothing new. There were three historic concepts about space elevators that were systems reasonable for each of their times.

- Konstantin Tsiolkovsky, a Russian rocket scientist pioneered astronautics' theory and conceptualized a building growing to GEO orbit, in 1895. He wrote about building a tower on the equator in his essay.

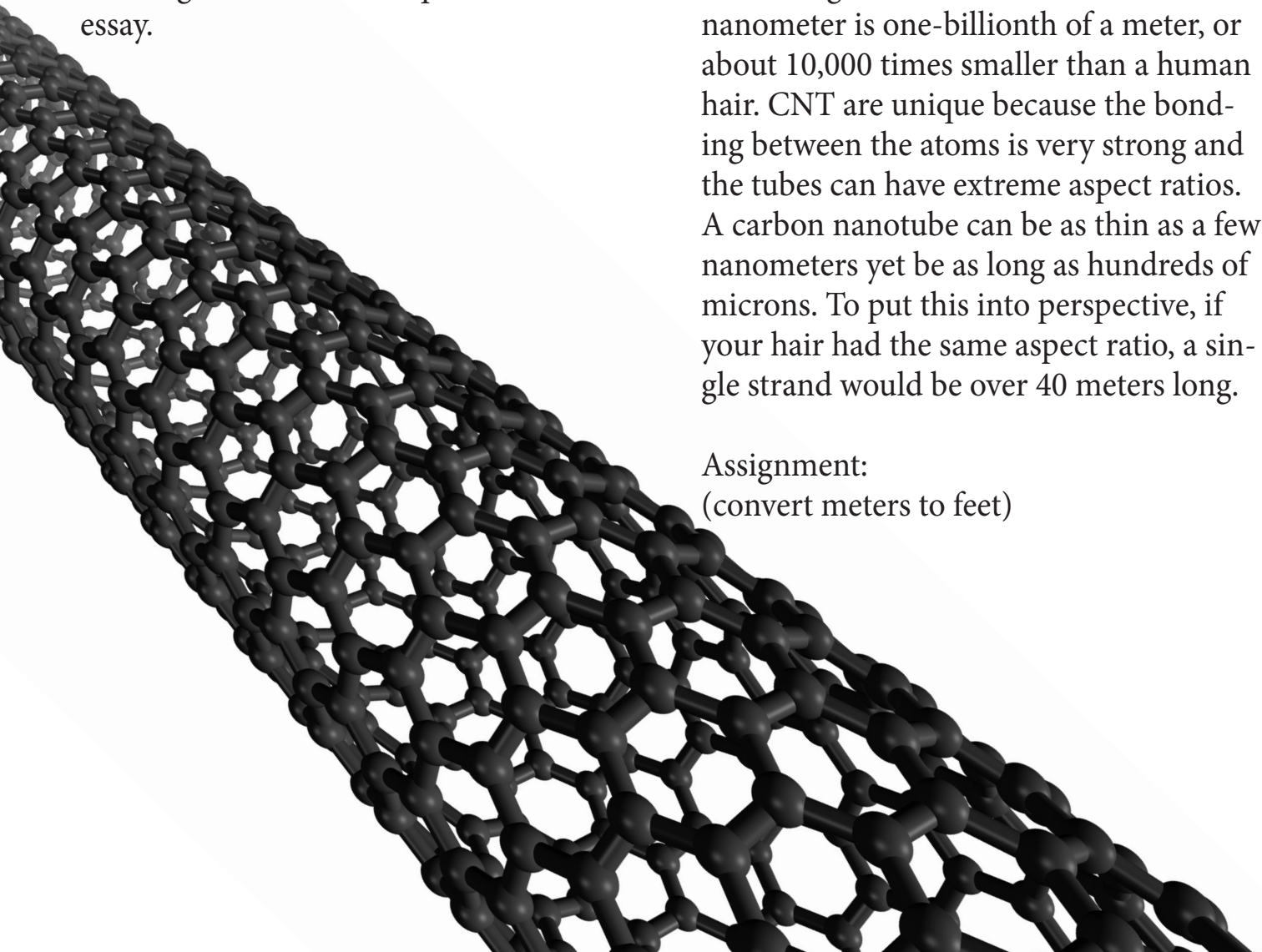
- The first player in the field to really deal with cables and layout a real concept was Yuri Artsutanov, who showed that you could stretch a cable from GEO down if the strength and lightness was significantly better than materials that existed in 1960.

- In 1974, Jerome Pearson published his engineering calculations showing that the space elevator could be stable and built from a GEO orbit .

Nano tubes are probably the answer.

A carbon nanotube is a tube-shaped material, made of carbon, having a diameter measuring on the nanometer scale. A nanometer is one-billionth of a meter, or about 10,000 times smaller than a human hair. CNT are unique because the bonding between the atoms is very strong and the tubes can have extreme aspect ratios. A carbon nanotube can be as thin as a few nanometers yet be as long as hundreds of microns. To put this into perspective, if your hair had the same aspect ratio, a single strand would be over 40 meters long.

Assignment:
(convert meters to feet)

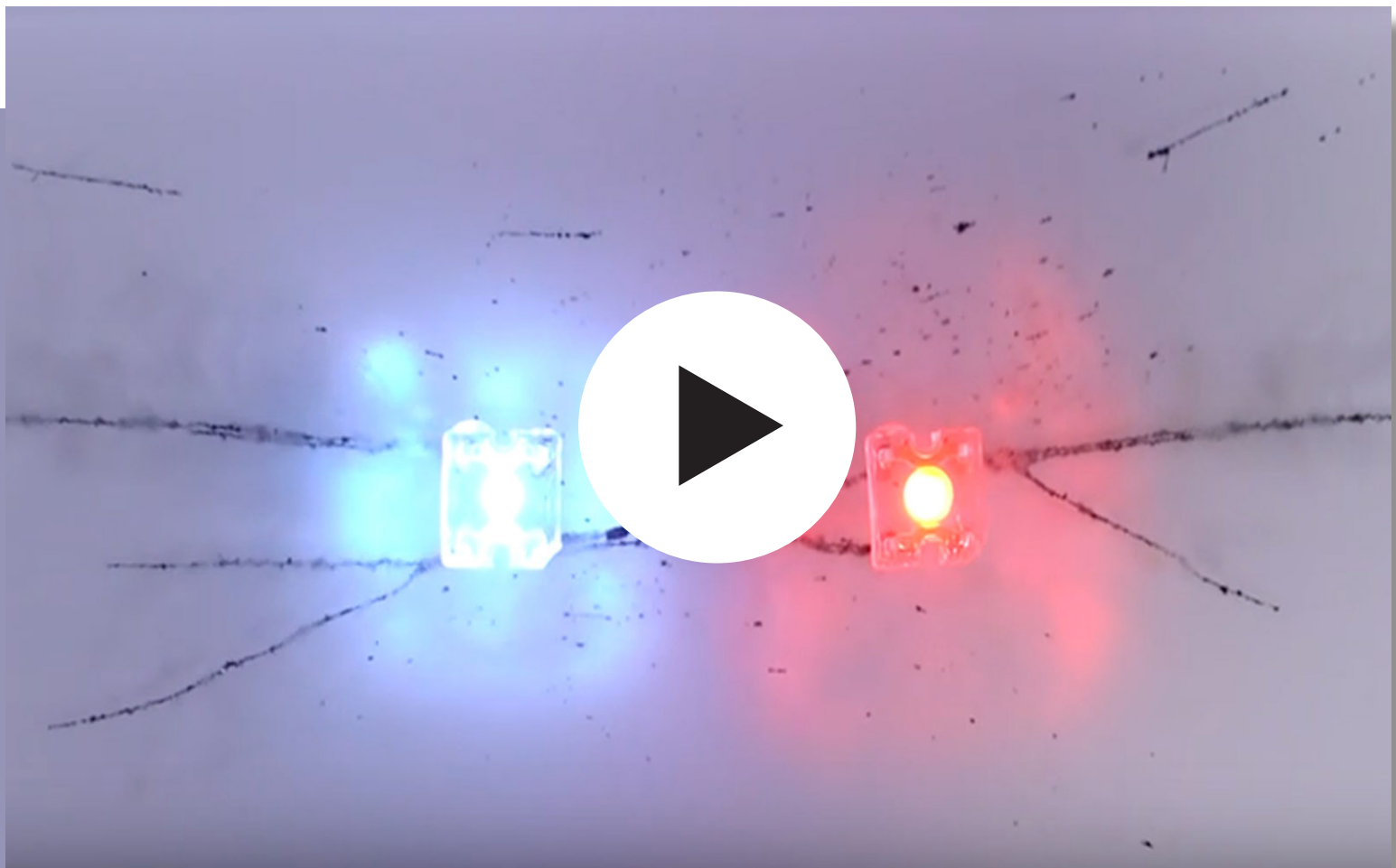


There are many different types of carbon nanotubes, but they are normally categorized as either single-walled (SWNT) or multi-walled nanotubes (MWNT).

A single-walled carbon nanotube is just like a regular straw. It has only one layer, or wall. Multi-walled carbon nanotubes are a collection of nested tubes of continuously increasing diameters. They can range from one outer and one inner tube (a double-walled nanotube) to as many as 100 tubes (walls) or more. Each tube is held at a certain distance from either of its neighboring tubes by inter-atomic forces.

The discovery of carbon nanotubes (CNT) in 1991 opened up a new era in materials science. These incredible structures have an array of fascinating electronic, magnetic and mechanical properties. CNT are at least 100 times stronger than steel, but only one-sixth as heavy, so nanotube fibers could strengthen almost any material.

Nanotubes can conduct heat and electricity far better than copper. CNT are already being used in polymers to control or enhance conductivity and are added to anti-static packaging.

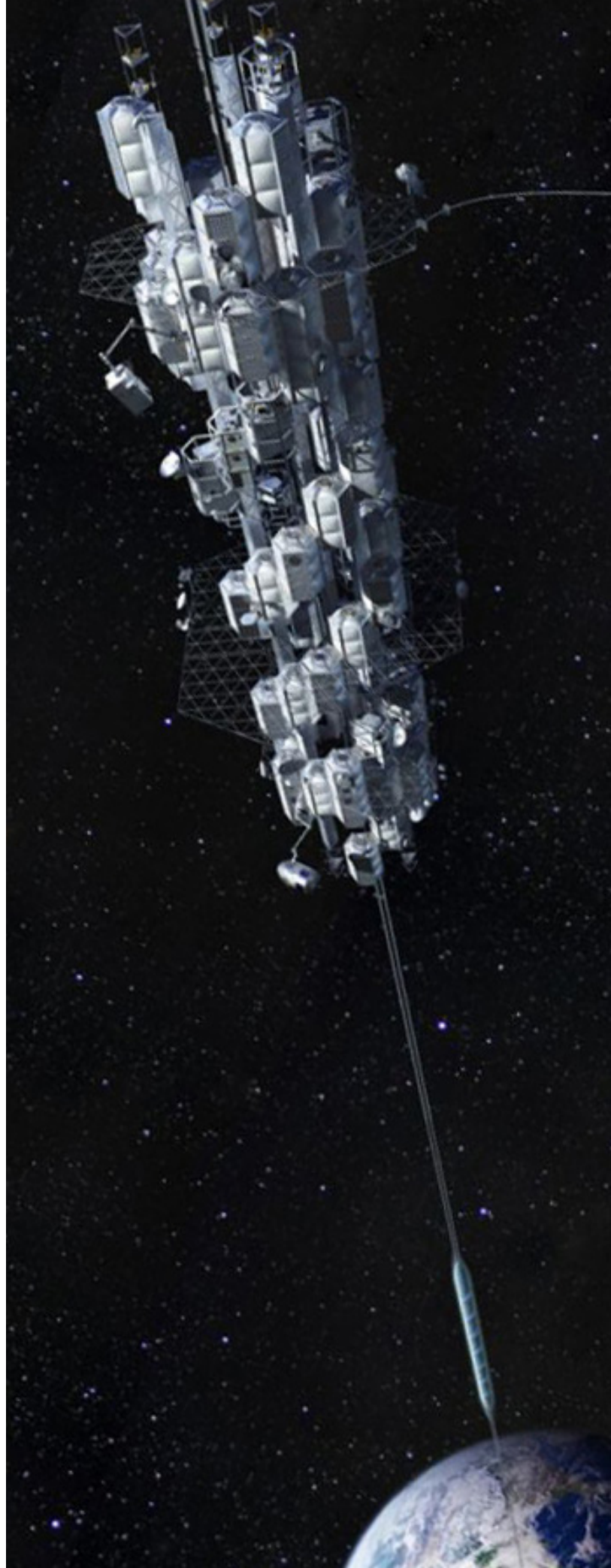


The potential global impact of the space elevator is drawing comparisons to another great transportation achievement -- the U.S. transcontinental railroad. Completed in 1869 at Promontory, Utah, the transcontinental railroad linked the country's east and west coasts for the first time and sped the settlement of the American west. Cross-country travel was reduced from months to days. It also opened new markets and gave rise to whole new industries. By 1893, the United States had five transcontinental railroads.

The idea of a space elevator shares many of the same elements as the transcontinental railroad. A space elevator would create a permanent Earth-to-space connection that would never close. While it wouldn't make the trip to space faster, it would make trips to space more frequent and would open up space to a new era of development.

Perhaps the biggest factor propelling the idea of a space elevator is that it would significantly lower the cost of putting cargo into space. Although slower than the chemically propelled space shuttle, the lifters reduce launch costs from about \$20,000 per pound, to approximately \$400 per pound.

You may have a job waiting !



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