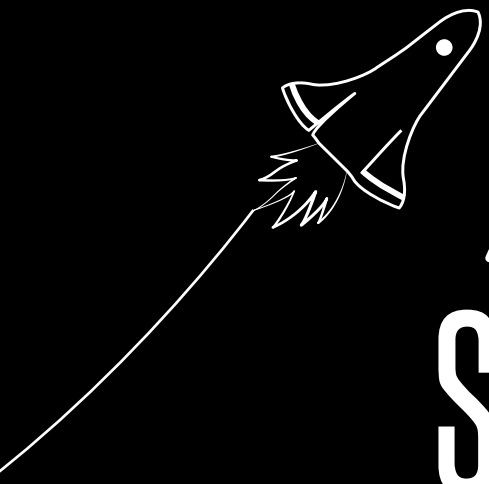
National Aeronautics and Space Administration



INTERNATIONAL

SPACE APPS

CHALLENGE

2013 MISSION REPORT

TABLE OF CONTENTS

3	**Executive Summary**
6	Introduction - To Explore
10	Infographic - Space Apps in Numbers
12	Chapter 1 - Mass Collaboration
20	Chapter 2 - Community
30	Chapter 3 - Challenges
40	Chapter 4 - Solutions
44	Chapter 5 - Conclusions
50	Appendix
109	Credits

EXECUTIVE SUMMARY

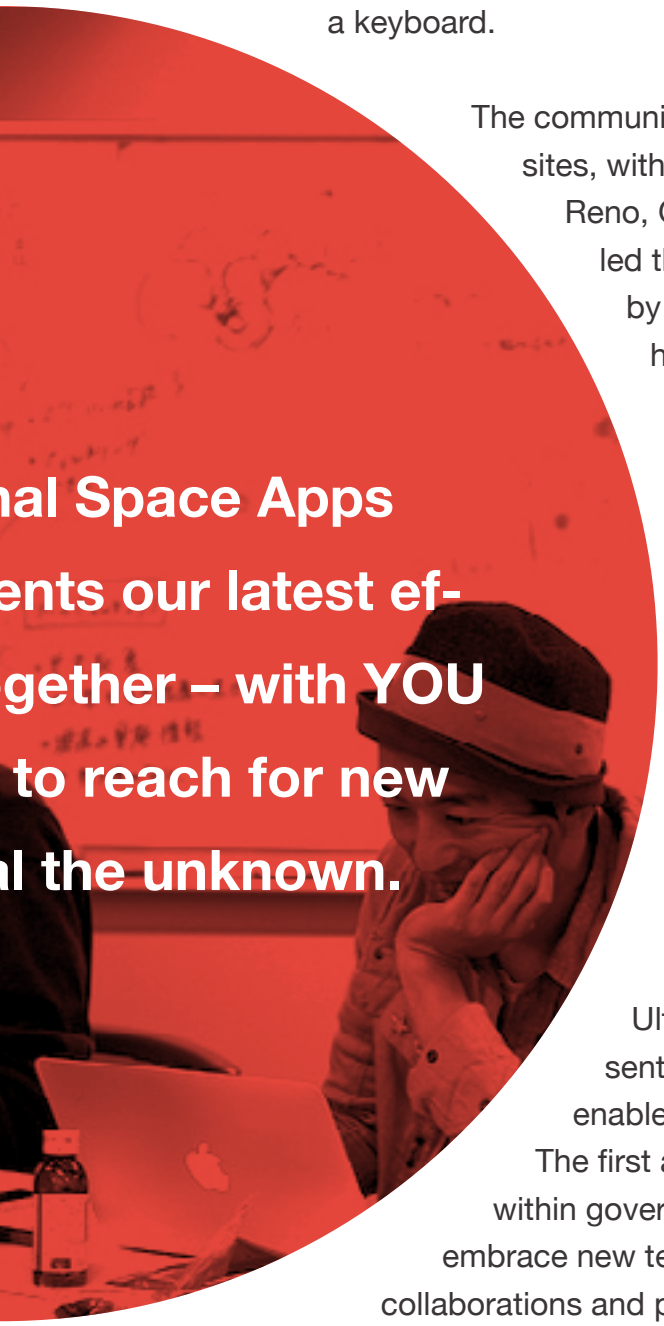
The International Space Apps Challenge is a two-day hackathon where teams of technologists, scientists, designers, artists, educators, entrepreneurs, developers, and students collaborate across the globe, using publicly available data to design innovative solutions for global challenges in software development, citizen science, hardware, and data visualization.

For the 2013 event, more than 9,000 global citizens in 44 countries and 83 cities engaged directly with NASA for the largest hackathon in history. In just 83 total hours they collectively developed awe-inspiring software, built jaw-dropping hardware, and created stunning data visualizations that collectively went a long way to improving life on Earth and in space. The results? An unbelievable 770 solutions were submitted, thousands of people worked together to address challenges, and an immeasurable amount of enthusiasm and investment in exploration was created.

In addition to the event's significant footprint around the globe, over 2,200 people participated virtually from less formal locations. They gathered at coffee shops, libraries, community centers, and their own homes to contribute to the global effort. Both the virtual participants and the participants in physical locations found

each other through matchmaking functionality around each of the challenges, forming teams that spanned the globe. People were excited to contribute their skills and ideas, including teams collaborating via Google Hangout; subject matter experts with no programming ability offering to work with any team to help solve the challenge; and the challenge sponsors getting actively involved with all teams working on their challenge to ensure they got the most from the weekend. While so much of the excitement of a hackathon is about physically working with others, 83 of the 770 teams spanned multiple locations and 65 of those included at least one virtual participant.

The International Space Apps Challenge – led by NASA and 474 other organizations, including 6 international space agencies, 11 US embassies, and 6 US federal government agencies – offered up massive amounts of data and other resources to teams of hackers who responded with creative solutions. The participants worked on 58 curated challenges, submitting at least 2 solutions for each challenge, with some of the most popular challenges receiving many more. Over 40 solutions were created for asteroid-related challenges and 37 solutions for our Spot the Station challenge. Participants designed CubeSats for our upcoming Mars mission, integrated wind, solar, and geothermal energy data, and created data visualizations to improve the air traffic control system and track satellites and solar electric propulsion. The first interplanetary weather app was developed using actual Mars science data and visual imagery, such as highlighting temperature and dust storms. A low-cost underwater rover using lights, thrusters, and video cams was built in San Francisco; a team in NYC then manipulated the craft in San Francisco using Skype and



a keyboard.

The community drove the development of youth engagement across sites, with focused efforts in 7 locations (Toronto, Philadelphia, Reno, Guayaquil, Managua, Brisbane, and Glasgow). Toronto led the way with their 150 students aged 7-15, who began by imagining what exoplanet aliens might look like with the help of planetary scientists on-hand and created them with 3S modeling software. They then printed their aliens on 3D printers to take home. Also at the event, kids took photos of their alien creations and themselves in space attire against a green-screen backdrop for the Wish You Were Here interplanetary vacation post-cards. For the Listening to the Stars challenge, youth participants provided the soundtrack to the event by mixing music and space sounds on DJ consoles. For fun visual effect, they also poured cornstarch and water over horizontal subwoofers, producing writhing tentacle "oobleck." Not to leave CubeSats out, kids made origami CubeSat prototypes.

Ultimately, the International Space Apps Challenge represents our latest efforts in working together – with YOU – to enable us all to reach for new heights and reveal the unknown. The first and second annual events have been an experiment within government to adapt to the changing external environment, embrace new technologies, engage with our citizens, and encourage collaborations and partnerships. **This is the result of the government recognizing that we can be more relevant for our stakeholders and intentionally create a culture of openness. This is crucial as we attempt to evolve into a twenty-first century space program for a twenty–first century democracy.**

At NASA, we are committed to pioneering the future. We have a long history of achieving seemingly impossible goals, from reaching the Moon to advancing fundamental knowledge about our home planet. Today we work to understand the universe's origins, map its current state, and analyze its effects on our future. We are inherently passionate about solving the grand challenges of our day. NASA has a mandate to be bold, take risks, and do what intimidates most others – the things that not only inspire our nation, but the world. We are just beginning to embark on an ambitious program of space exploration that will build on new technologies and expand our reach into the solar system, including new destinations never before visited by humans. These grand challenges we are now focused on cannot be solved alone. NASA needs your help.

INTRODUCTION
TO EXPLORE

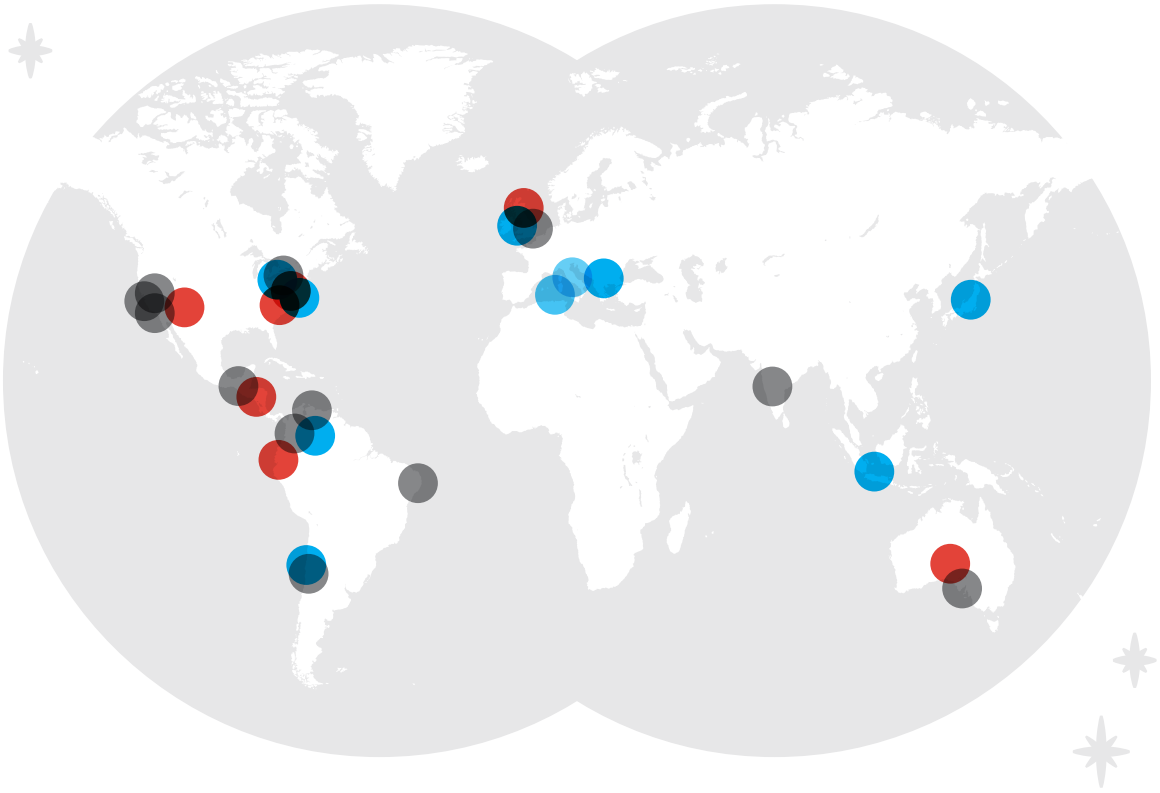
Our space program, more than ever, requires the active engagement of the public to co-create our future. The grand challenges we collectively face are monumental and complex. Long voyages through deep space are filled with many dangers, yet the challenges we face here on Earth are even more daunting – millions of people without access to clean water, a growing demand for a limited supply of natural resources, and ecosystems changing more rapidly than ever before. Often, however, the solutions to issues both on Earth and in space stem from the same ideas – and as technology advances, new developments are born every day that contribute to both contexts.

To truly accomplish the immense task NASA has been given, we are working to develop new ways to enlist citizens around the globe to contribute their time, talent, and creativity to help us solve the grand challenges of our time. This is especially true in times of shrinking budgets, constrained resources, and increasing demands for a more open and transparent government.

The 2013 International Space Apps Challenge was the culmination of months of planning, years of experimentation, and tens of thousands of hours of hard work from people across the planet who share in the excitement of building our collective future. The initiative is our grand experiment in participatory exploration and serves as a tangible example that we are in a new era of exploration – one that has great promise. It marks a shift in the way the Agency interacts with the public and conducts its exploration mission. No longer is exploration and discovery limited to the governmental engineer, scientist, or astronaut – we all now have the power to contribute to a mission greater than ourselves.

WE ARE ALL EXPLORERS.

SPACE APPS IN NUMBERS



TOP 10 CITIES

New York, Santiago, Toronto, Sofia, Tokyo, Jakarta, Limassol, Bogota, Rome, London

SOLD OUT LOCATIONS

Adelaide, Bangalore, Bogota, Guatemala City, London, Monterrey Mexico, Recife, San Francisco, Santa Cruz, Santa Marta, Santiago, and Toronto

EVENTS & CHALLENGES FOR STUDENTS

Toronto, Philadelphia, Reno, Guayaquil, Managua, Brisbane, and Glasgow

MOST POPULAR HARDWARE

Lego Rovers, ArduSat

MOST POPULAR NASA

Spot the Station, Why We Explore, Database of NEOs

MOST POPULAR EXTERNAL

Reach for the Stars, Renewable Energy Explorer, Backyard Poultry Farmer

MOST POPULAR SOFTWARE

Spot the Station

TOP TEN CITIES BY PROJECTS PRODUCED

REGISTERED PARTICIPANTS		
347	33	NEW YORK
368	28	SANTIAGO
180	26	TORONTO
142	24	SOFIA
137	22	TOKYO
129	22	JAKARTA
125	19	LIMASSOL
124	18	BOGOTA
206	17	ROME
126	16	LONDON

218
MEDIA ARTICLES

83
TEAMS THAT COLLABORATED WITH AT LEAST ONE PHYSICAL LOCATION

65
VIRTUAL TEAMS THAT COLLABORATED WITH AT LEAST ONE OTHER LOCATION

NORTHERNMOST LOCATION
TAMPERE, FINLAND

ANTARCTICA
SOUTHERNMOST LOCATION

3.9
AVERAGE TEAM SIZE

18
LARGEST TEAM SIZE

LOCATION AT HIGHEST ALTITUDE
KATHMANDU, NEPAL

57 CHALLENGES

484 ORGANIZATIONS

83 CITIES

44 COUNTRIES


9,150 PEOPLE
474 ORGANIZATIONS
83 CITIES
44 COUNTRIES
770 SOLUTIONS
NASA
NASA
SPACE APPS
CHALLENGE
KATHMANDU

CHAPTER ONE

MASS COLLABORATION

Collaboration on a massive scale is the future of government innovation.

Government-led mass collaboration increases efficiency, transparency, and direct civic participation, while aligning the agency's work with private sector innovation processes.

Participation in the collaborative process creates increased awareness as well as mutual public-private stake in the outcome and implementation.

The International Space Apps Challenge provided a unique opportunity for NASA to advance technology development while engaging citizens worldwide in meaningful participatory exploration.

How do you engage thousands of people around the world in NASA's mission? This was the challenge we set out to tackle with the International Space Apps Challenge.

Admittedly, engaging the masses in this way has previously been very hard for government. Although government has always been a platform for collective action, it's never really been an efficient one at connecting people together and scaling their participation in a focused and useful way. At NASA, we are in the midst of a massive change. The external environment of the aeronautics and space sector is undergoing a shift in how business is conducted. The core of NASA's strategy for extending humanity into the solar system recognizes the ingenuity of citizens as a rich resource to develop more capable and innovative technologies and to create a thriving commercial space sector.

Thanks to technology, connecting people to what we do inside government does not have to be complex. It is not rocket science. The formula is simple.

The more government enables people who fundamentally care about it and want to contribute to the future of our world, the better chance we will have to help our governments live up to their true potential and develop solutions to the grand challenges of our time.

Here's the key: it's not just about individual participation; it's about mass collaboration. Mass collaboration is the deliberate engagement of a broad group of diverse participants in collective action focused on generating innovative and relevant solutions to the most pressing problems. Mass collaboration represents an inexorable and rapidly advancing shift towards a new way for individuals, communities, and institutions to engage with one another across boundaries and barriers around the challenges that we all share.

Mass collaboration is particularly possible today because of the Internet and our place in history.

It is technology that enables the creation and application of ideas at scales previously unimaginable, in a focused way. In fact, it is collaboration on a massive scale that will lead us to a new future of government innovation.

Using technology, organizations can now aggregate unlimited contributions – no matter how small – from a number of sources, and focus the results to create a solution that will scale and have a big impact. Crowdsourcing innovation makes a lot of sense for organizations who are interested in navigating the nuances of doing business in the digital age. However, not all approaches are equal, and we have witnessed that competition breeds very different results than collaboration.

Mass collaboration requires the right combination of incentives and systems to amplify small time investments by citizens into vast creative contributions with concrete results, then focus those results towards directly impacting the mission of their organization.

Fortunately, NASA isn't exactly known for thinking small. Instead of resting on past achievements, NASA has always been about reaching for the future. We know that in order to solve the grand challenges of our time, we must find groups of people, bring them together around an issue or problem that needs to be fixed, then step out of the way and let the collective energy of the people involved solve problems in creative and imagina-

tive ways that we would never have done ourselves. Recognizing that NASA didn't have a way to engage citizens in such a scaled and relevant way, we set off to create one. In 2012, the Open Innovation Program led the first International Space Apps Challenge. It was the largest government-led mass collaboration event to date, and a real testament to what people can do together if given the permission, opportunity, and resources.

The solutions developed at the event were so impressive, and the demand to do another event like it so strong, we decided to host a second International Space Apps Challenge in April 2013.

The event demonstrated that thanks largely to the Internet, the kind of creativity and innovation that used to take place primarily behind closed doors within large institutions is increasingly taking place by people simply connected online.

In planning the 2013 International Space Apps Challenge, we dreamed big and set many goals. We wanted to "liberate" government data to fuel entrepreneurship, improve transparency, create opportunities, fuel economic growth, and improve the lives of citizens from around the world in very tangible ways. Our approach was to prioritize the challenges most worth solving, build a platform to engage a large, diverse group of participants around the challenge, incentivize them through collaboration to develop a solution, and then let the best ideas rise to the top naturally. It was an experiment in new ways of harnessing the potential of mass collaboration in order to connect you to space. The purpose was not

only to develop new technology, or even solve tough problems, but to fundamentally improve government – to make it more open and participatory. In the end, the International Space Apps Challenge proved to be a unique opportunity for NASA to advance technology development while engaging citizens worldwide in meaningful, participatory exploration.



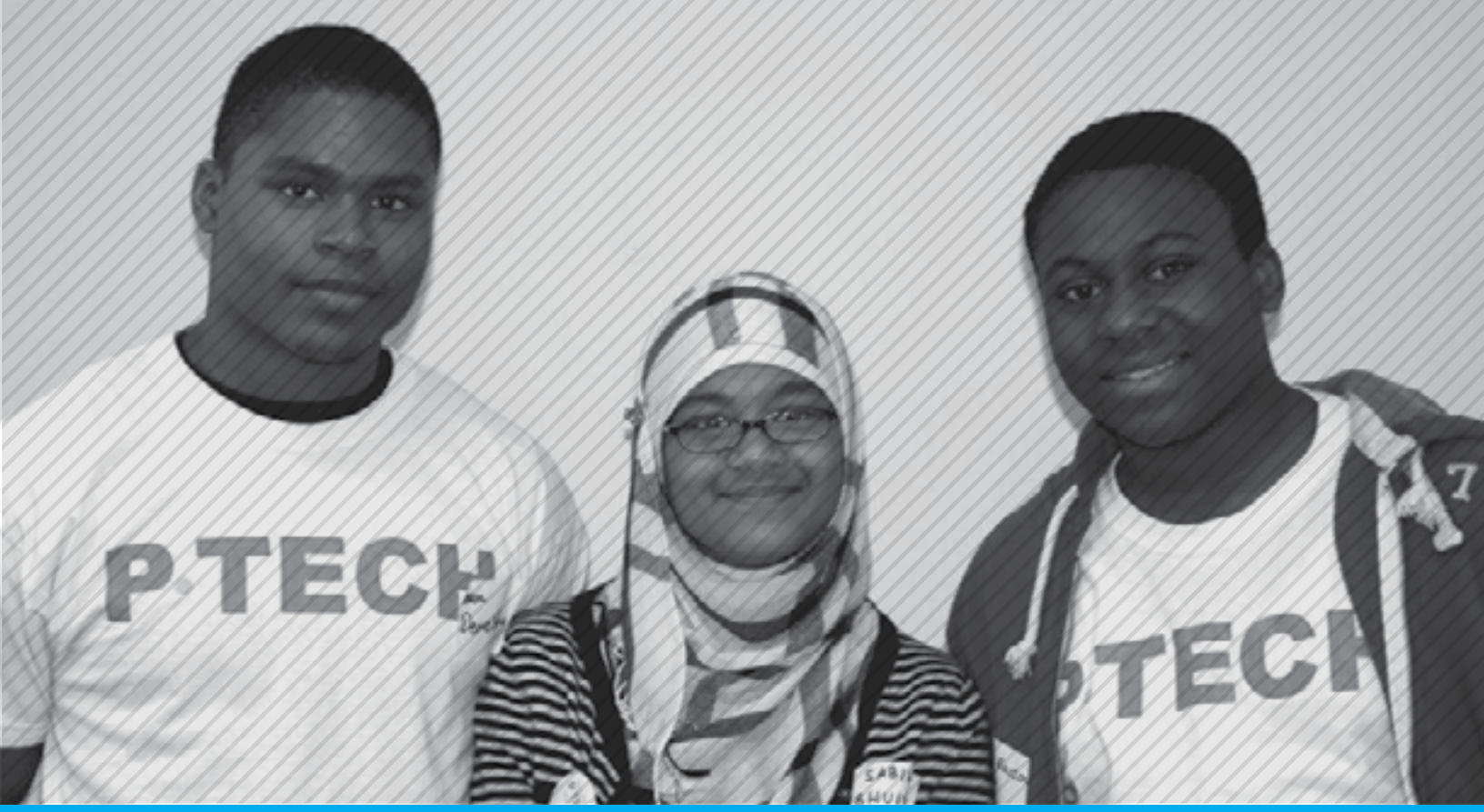
WORDS FROM
THE COLLABORATORS

In the end, no money exchanged hands, no job offers were on the table and no thank-yous were expected by any of these people, yet they were all willing to give almost three days of their lives to make something that might help others or help humanity as a whole.

GARY NOLAN, SPACE APPS CLEVELAND

I learned a lot about local and global teamwork; fantastic how that works, and what an enthusiastic people working around the clock.

ERIK KUULKERS, SPACE APPS ROME



Space Apps shows that there is great potential in our country.

MARIA ZAGHI, SPACE APPS GUATEMALA CITY

Weekends are for movies, treks, or visits not for serious works. But all of us were more than happy to spend the two days in a unique manner, learning, sharing, enjoying, working, and networking.

RINU MAHARJAN, SPACE APPS KATHMANDU


spaceappschallenge.org

CHAPTER TWO

COMMUNITY

The community is a platform for innovation and collaboration.

Technology enables the community to grow virtually around ideas and shared opportunities, rather than just via physical proximity.

The community's involvement in Space Apps and participation in exploration challenges extends far beyond just the weekend event.

Mass collaborations allow agencies a new level of access into incredible pockets of innovation worldwide.

Collaboration is the key to addressing the most important challenges of our time – and community is the platform that makes collaboration possible. Community grows, first and foremost, by working together to accomplish a goal.

It is the global community that holds a diversity of perspective and approach to those grand challenges, and their wealth of cultural, professional, and practical experience adds a value achievable only through the crowd. Not only are the best, brightest, and most passionate global leaders bringing their own expertise, they have volunteered to build and bring their communities to contribute to this effort.

The unique model of a centrally led global effort composed of independently led local events is an extremely flexible one, giving participants a contextualized personal experience that can also be networked across nations, cultures, and disciplines. Space Apps prioritized a bottom-up community creation model that empowered all of the participants to connect with each other around the challenges and projects they worked on.

The most enthusiastic members of the Space Apps community have an opportunity to deepen their investment in Space Apps: they can focus on community development and engagement by becoming local leads. The core global team invests in and mentors local leads, who in turn engage and support their local participants, a regional management approach enabling the event to scale on low resources without losing its vision.

More than 60% of the the local leads who led a local event at the 2012 Inter-

Toronto engaged 150 students at once with a parallel youth-focused challenge.

national Space Apps Challenge returned to lead again, and more than 60% of the new leads at the 2013 had participated in the 2012 event. The local leads were a particularly diverse group: Space Apps Syracuse was led by senior students at Syracuse University's iSchool. The Met Office UK, the UK's national weather agency, led Space Apps Exeter, and Google Lunar X Prize team Indus led Space Apps New Delhi. The Paris location was led by a previously unconnected group of volunteers.

Space Apps Rome was led by the European Space Agency in partnership with the US Embassy in Rome, and the Pretoria location by the World Bank's mLab South Africa. A team of NASA civil servants directed Space Apps KSC – the first NASA-led local event.

Each approached their event with a different perspective, giving it a flavor unique to their culture and experience, and it is these individuals who truly foster and cultivate the community. Santiago, Chile was the largest site; 50% of New York City's participants were female; in Port-au-Prince, Haiti high school students built simulators to explore and experience sustainable living. Space Apps Jakarta held satellite events in outlying villages where they judged projects over the phone. Tokyo celebrated with sushi in the shape of the Space Shuttle. Toronto engaged 150 students at once with a parallel youth-focused challenge.

Enabling the community to grow virtually by providing the right technology to do so is essential. It's the Internet that truly enables collaboration without the limits of proximity, and virtual tools permitted communication, data-sharing, and the exchange of ideas, as well as allowing locations to engage other locations during the event. More than one-third of submitted projects had at least one virtual team member.

True participatory exploration doesn't produce events, though, or even products – it cultivates explorers, creative thinkers, and makers.

Community must continue to thrive and grow outside of one weekend a year, of course. One of the standards of success will be what the community does on its own time and of its own accord to carry forward the values of the International Space Apps Challenge: to engage the experience and enthusiasm of a diverse global community to address critical challenges for life on Earth and in space. We continue to receive stories, particularly via social media, about teams who carry projects forward into other hackathons, apply for internships, and create other space-themed events together – all based on what that original community developed in the context of collaboration. One group of participants in Eastern Europe sent a completely packaged app back to NASA with this note: "We keep on working and developing our concept because we are serious about contributing the impact that we are talking about [and seeing it] become reality."

The conclusions from the 2012 Challenge final report remain true: “All of the solutions have applicability on Earth and in space, but we continue to emphasize that the community that was built around Space Apps was the largest success of this undertaking. We hope that the community remains engaged as NASA continues to move forward in space exploration, collect more data about the unknown, and open up more data from the missions of the past, present, and future.”

SPACE APPS
PHILADELPHIA

"For 6 months in 1876, Philadelphia hosted the US Centennial Exhibition, attracting over 10 million visitors from around the world. Officially known as the "International Exhibition of Arts, Manufactures, and products of the Soil and Mine," it showcased international collaboration and friendly competition around the latest scientific, technological, and artistic advancements. Over 137 years later, Philadelphia once again captured the world's attention for 48 hours in April 2013 as the Global MainStage host of another international collaborative and competitive event centering on science, technology, and the arts: the International Space Apps Challenge.

From local astronomer Derrick Pitts' insistence that Philadelphia is more of a science city than many think, to our over 50 participants grabbing a traditional Philly lunch from a streetside food truck, to our iconic t-shirts featuring "Rocky" in a space suit, Space Apps Philadelphia was filled with local flavor. This was many participants' first hackathon – cross-promotion with PhillyTechWeek and the Philadelphia Science Festival helped draw in newcomers. At 14-years-old, Philly's youngest participant helped craft the winning team's International Space Station tracking device with an Arduino microcontroller and locally manufactured K'NEX building kits. Even civic hacking veterans, including

those from lead organizer Azavea, were excited – in particular by the arrival of NASA astronaut Leland Melvin and the Space Apps global team. Our location host, Youngmoo Kim of Drexel University's STEAM-focused ExCITe Center, joined in on the "Listening to the Stars" challenge by playing the sounds of stars through the electromagnetically-enabled piano strings of a specially modified Magnetic Resonator Piano.

Philadelphia teams collaborated locally, as well as with sites in Georgia and Florida. This year's Global MainStage in the "Workshop of the World" was locally-tied, globally-minded, and widely celebrated by Philadelphia's diverse and growing science and technology community."

ANDREW THOMPSON
SPACE APPS PHILADELPHIA LEAD

SPACE APPS
KATHMANDU

“Namaste! Kathmandu reporting...

Cheers and applause becomes louder than before when Mr. Basanta Shrestha, regional coordinator of NASA SERVIR-Himalaya program, says Kathmandu sits highest among cities that are hosting this hackathon episode. He further says he plans to host the next episode even
higher, and cheers get even more louder.

Everybody is proud, enthused, and excited to complete their projects. Bonds are deepening among participants and smiles are getting wider. Today is the second day of the two, and organizers have gone braver and are playing heavy metals. Participants are on the mood.

The mass inside this closed hall looks like an army of innovators; with full ammo of Arduino, software, hardware, and passion. Yesterday, I surprised myself by being able to work a whole day and enjoy it. I was working on building a 3D animation of our Sano Curiosity (Sano = small in Nepali). Immense satisfaction followed as soon as I finished

the animation in a day.

We feel like we are getting more by giving to the world. Experience, idea, and friends. Thank you NASA."

KSHITIZ KHANAI
SANO-CURIOSITY PROJECT (CURIOSITY AT HOME)


57 CHALLENGES
GLOBAL COLLABORATION
NATIONAL RENEWABLE ENERGY LABORATORY
GLOBAL INNOVATION

CHAPTER THREE

CHALLENGES

Contributing to solutions for challenges that matter is the core motivation for most participants in mass collaborations.

Diversity of type, scope, subject, and methodology is key to developing a good slate of global challenges.

Inviting other agencies and organizations to share like-minded challenges also builds interagency collaboration, and a foundation for future data-sharing.

The ability to contribute work toward solving meaningful challenges is the most important motivator for most participants in mass collaboration. At the International Space Apps Challenge, NASA and its partners carefully crafted and refined 57 challenge statements and directed the energy of global innovators to them.

The ability to contribute work toward solving meaningful challenges is the most important motivator for most participants in mass collaboration. At the International Space Apps Challenge, NASA and its partners carefully crafted and refined 57 challenge statements and directed the energy of global innovators to them.

Curation of challenges is an extensive, multi-phase process. The team began by reaching out to stakeholders across NASA's mission directorates and organizations to help figure out what challenges they faced that could be addressed via mass collaboration. The initial pool of ideas and datasets was then further developed by a group of technologists and local leads to thoroughly define requirements and gauge interest in the various efforts. Each challenge had the same goal: provide innovators with all of the information they need to learn about a topic, understand the challenge statement, and craft a solution in less than two days.

Each challenge sought to leverage NASA's massive datasets and open source software technology. Just browsing the challenges, one can quickly see that an overarching goal of the event was to increase awareness and interest in space

The global collaboration of Space Apps can be fertile ground for strongly defined challenges that have very specific needs in mind.

exploration and aeronautics by opening up the Agency's extraordinary data.

Challenges included software applications, hardware projects, data visualization, and citizen science platforms. A concerted effort was made to include ideas with well defined requirements and specific deliverables, as well as more open-ended, creative projects. Diversity of subject matter, required expertise, and output are all necessary for a robust set of challenges that can resonate with as many participants as possible. This is a global initiative and the diversity in the challenges must reflect the diversity of the innovators that participate.

These challenges may not garner a high volume of solutions, but the teams that do commit are often highly invested in the subject matter and goals at hand. An example this kind of challenge is Soil Testing Kit, which laid out the development requirements for an app that could harness crowdsourcing to measure and test soil samples using mobile technology.

Open-ended challenges are just as important. They allow creativity and innovation to flourish without boundaries. This exploration can sometimes result in frustration, but just as often results in new learning and greater impact than anyone could have hoped for. This includes Reach for the Stars, an open-ended challenge to create an app that

inspires youth participation in space exploration, and Why We Explore, which asked participants to share the "why" of space exploration through the creation of compelling narratives and visualizations. The European Space Agency's 3D Printing Contest solicited designs of ESA space hardware that can be generated by a 3D printer. Listening to the Stars sought to recreate sounds of space using Earth-bound objects. Every one of the 57 challenges was unique and contributed to this impressive diversity. A great example of an open-ended project with a clear topic focus is NASA's Database of Near Earth Objects, a challenge to create a platform to enables citizen astronomers to register, submit findings, and help rank the findings of other citizen astronomers.

Contributing challenges to a mass collaboration also gives government agencies or other technical organizations an entry point into a community to help test the water for an idea or larger initiative.

The US Department of Agriculture, the National Renewable Energy Laboratory, the Peace Corps, and the Environmental Protection Agency were just a few of the US government agencies who partnered with Space Apps this year for project development, but also to experience the event from the inside in the hopes of furthering similar efforts in their own spheres of influence. Agencies like the European Space Agency, Sally Ride Science, and i.am.angel Foundation were also invited to offer challenges as an investment in mutual collaboration, particularly around shared goals and datasets of shared interest.

This type of initiative can be a vital tool for agencies working in a severely limited budgetary and political environment. The International Space Apps Challenge harnessed the entrepreneurial spirit of innovation that accurately represents what the future of space exploration is all about – expanding our knowledge of the solar system and our relationship to it so that we can make life better here on Earth.

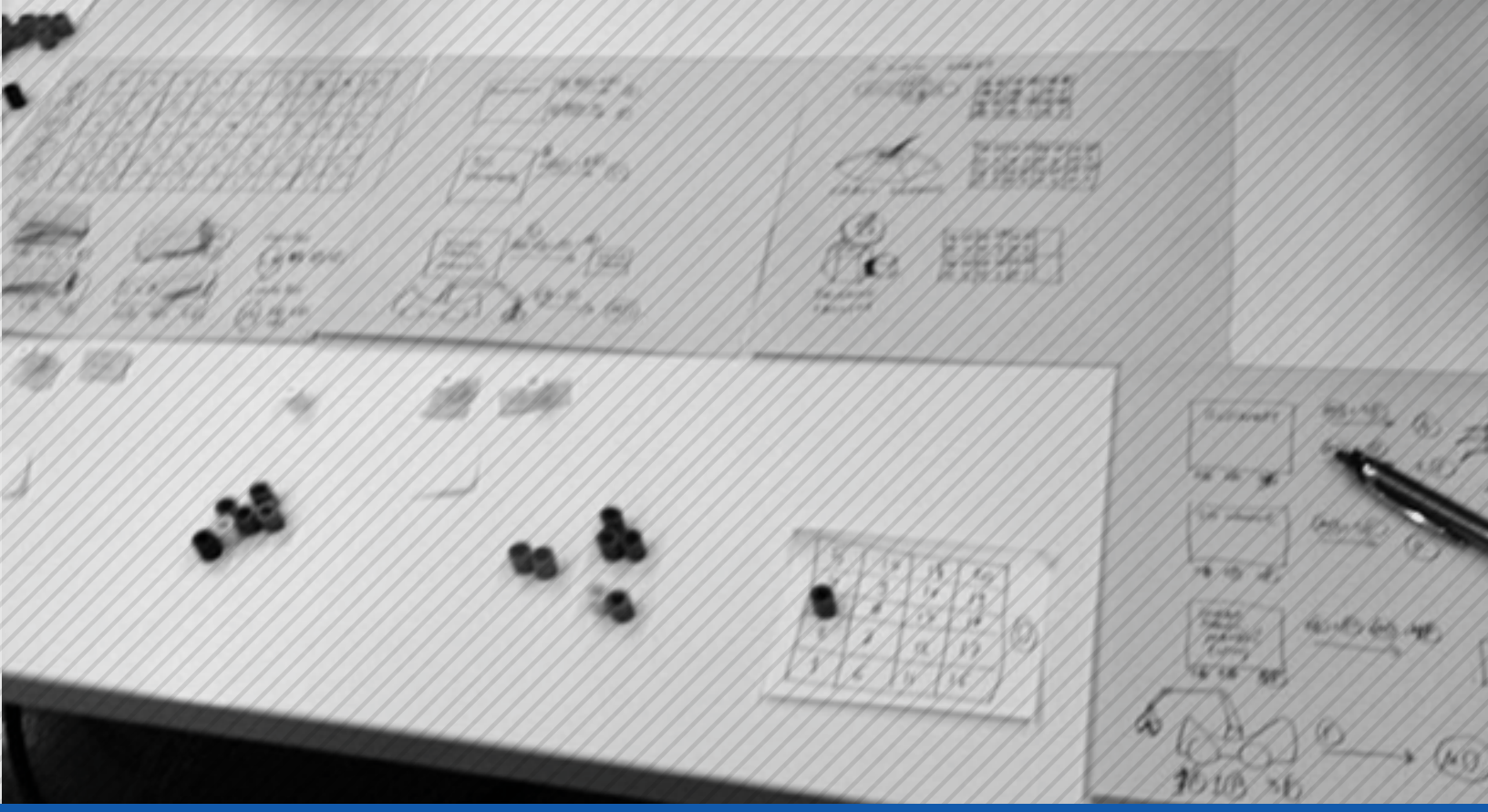
THE LEGO ROVERS
CHALLENGE

“I submitted a challenge based on a STEM activity I had been running in schools in the North West of the UK: Design a remote operation system to control a Lego Robot through a computer or smartphone.

I was overwhelmed by the response to the challenge. Over thirty project teams worldwide took it on, producing everything from more easily installable versions of the original system; to versions of the system that ran on arduinos or raspberry pis; to new programming languages for distributed autonomous programming of multiple robots! I spent several days before the challenge answering a wide range of probing questions on the challenge web page.

During the challenge itself I worked with a team in Exeter re-engineering the existing system so that it could be operated via a web server with a mobile device friendly interface. I had a great time working with a range of talented people who brought a great diversity of skills to the problem.

Going forward, I’m looking into applying for some funds here in the UK to get some



more equipment for the Lego rovers, particularly the NXT2Wifi system used by the team in Paris. I'm also planning to try out several of the systems produced from the hack-athon. I particularly have my eye on NXTSpaceApps from Paris, Lego Rovers Singapore, and DisCoS from Abu Dhabi."

DR LOUISE DENNIS

CENTRE FOR AUTONOMOUS SYSTEMS TECHNOLOGY

THE “OFF THE GRID”
CHALLENGE

Many challenges provided a variety of resources and guidance while ultimately being open-ended in nature. This sparked some incredible insight and innovation beyond what the challenge definers could have ever hoped for!

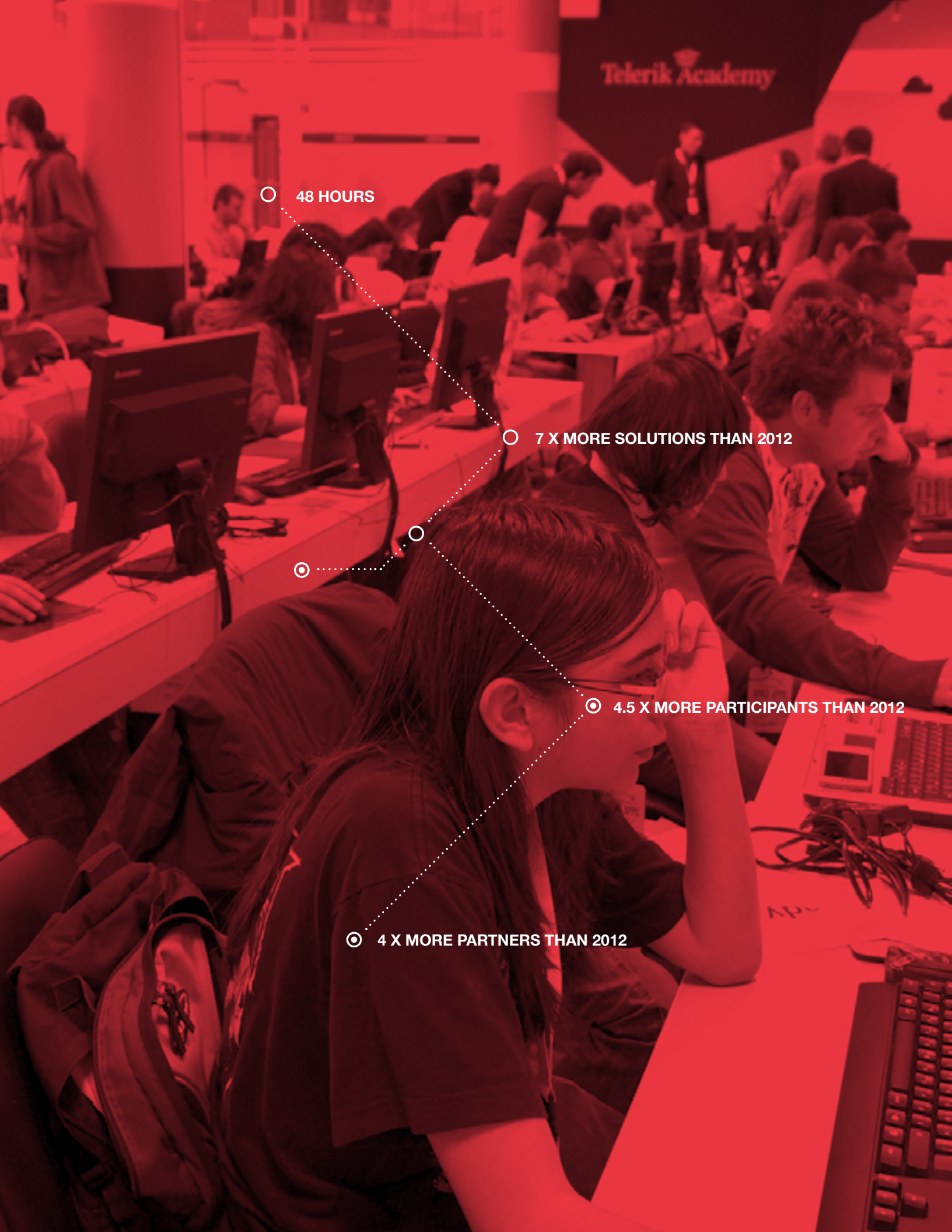
Off the Grid challenged participants to discover and promote sustainable living, using technologies and data from Earth and space. Josh Pruden, Joel Gamache, Scott McKay and Greg Linton from Winnipeg, Canada chose to tackle the Off the Grid challenge from the perspective of Life On Mars and targeted at high school teachers. Dario Schor, the organizer of the Winnipeg event, shares their story with us:

“We believe students can solve any problem we give them. So we’re making an online course designed to promote sustainable development and living off the grid by guiding the students to plan a human habitat on mars. Specifically we’re creating an online Moodle resource that teachers can use for their classes.

“Just because the colonization of Mars is a big challenge doesn’t mean students shouldn’t get involved. Few things spark the imagination of young people like planetary

and space exploration. The colonization of Mars has the potential to inspire the imagination of students, motivating them to pursue the topic. If we give them a direction and a good foundation we can harness and organize that imagination. Mars settlement is an abstraction of Earth settlement and development. If we can solve a problem on Mars, we can solve it back on Earth.

“For example, one activity starts with the students being given information on how to build a solar cell. From there they can chose to build their own cell or find other means of generating power on Mars. Next, the students have to find an effective way to apply the means of generating power to a Mars setting. By creating an online resource for teachers, we can help them develop the next generation of scientists, engineers, and innovators through the idea of sustainable problem solving.”


Telerik Academy
48 HOURS
7 X MORE SOLUTIONS THAN 2012
4.5 X MORE PARTICIPANTS THAN 2012
4 X MORE PARTNERS THAN 2012

CHAPTER FOUR

SOLUTIONS

Well-developed, innovative solutions are a product of effective collaboration.

A high level of challenge curation, along with well-structured supporting data, increases the likelihood of receiving sustainable solutions.

Solutions span the spectrum from concept ideation to prototypes and working demos to advanced, ready-to-use applications.

“In these times of financial constraint, the challenge is to be innovative about how we innovate.” NASA hears these words frequently, and yes, they conjure recursive thoughts of nested “do-while” loops and an *Inception* movie trailer, but the words are no less correct for doing so.

The challenge has always been how to remain innovative despite a highly scrutinized budget and conflicting mission priorities. The more clearly put challenge is this: NASA needs to be innovative in the way we do business, in order to allow for superior technological innovation. The solutions are found in the process as much as in the individual products.

The focal point of the Space Apps Challenge is the work done by the participants - the projects that are created over the 83 hours of the global event to address the offered challenges. The team-building and working process certainly became more efficient this year: while the team scaled the number of locations by more than 3 and the number of participants by more than 4, this year’s Challenge received more than 7 times the number of solutions.

The diversity of the 770 submitted solutions is breathtaking. Mission concepts were submitted for deployable greenhouses, including one that actually grew beans as a proof of concept. Hardware prototypes were built for Lego rovers, CubeSats, Arduino-directed robots, and electronic weather sensors. Advanced international strategies were deployed for weather sensing and soil testing. 6 projects integrated the brand-new LeapMotion gestural interface.ne team built a Martian weather API that fueled a number of weather apps.

Citizen science platforms were developed for microbial detection, NEO observation, and STEM interventions. Several projects were videos or animations.

At least 4 software applications have already been released on app stores. The breadth of these projects, and how well developed they were in only 48 hours, is a sign of the effective collaboration that took place throughout Space Apps.

Six solutions were awarded Best in Class for the 2013 International Space Apps Challenge by our panel of global judges:

Best Use of Data: The solution that best makes space data accessible or leverages it to a unique purpose or application.

Sol (Space Apps Kansas City)
Sol is the world's first interplanetary weather application. Rather than viewing the weather by inputting a user's zip code, they provide the planet whose weather they wish to view. The Sol team also built the MAAS API, used to fuel several of the Mars weather applications produced at the Space Apps Challenge. Developed by a team in Kansas City, Missouri and licensed under the MIT license.

Best Use of Hardware: The solution that exemplifies the most innovative use of hardware.

ISS Base Station (Space Apps Philadelphia)
ISS Base Station is a hardware-software co-design project both expanding the Spot The Station web app and allowing for a physical manifestation of its data. The software side of the project consists of a simple, Santa Tracker-style web app which tracks the position of the ISS in real time over a map of the

world, and connects to an augmented-reality iOS app which allows the user to track the station in the sky. The hardware side consists of a physical device which receives data from the app and points at the current location of the space station, and lights up when the station is within a user-defined area. Developed by a team in Philadelphia, Pennsylvania and licensed under Apache.

Best Mission Concept: The solution that developed the most promising mission concept.

Popeye on Mars (Space Apps Athens)
Popeye on Mars is a deployable, reusable spinach greenhouse for Mars. Internally, a fully equipped aeroponic system operates for ~45 days, having all the needed resources, sensors and electronic systems to stabilize the internal environment and help the spinach growth. Also, there are systems for harvesting produced oxygen during the process and the plants at the end of it. Externally, photovoltaic panels provide power, while several cover layers protect the system against Mars extreme conditions. Developed by a team in Athens, Greece and licensed under Creative Commons.

Galactic Impact: The solution that has the most potential to significantly improve life on Earth or in the universe.

NASA Greener Cities Project (Space Apps Gothenburg)
The NASA Greener Cities Project seeks to complement NASA satellite climate data with crowd-sourced microclimate data; in effect, providing higher resolution information for monitoring the environment. The design includes a low-cost garden monitoring sensor, aggregation and normalization of local environmental data, and scaling a global educational initiative for kids to encourage interest in programming and their environment. Developed by a team in Gothenburg, Sweden and licensed under Creative Commons.

Most Inspiring: The solution that captured our hearts and attention.

T-10 (Space Apps London)
T-10 is a prototype mobile application for use on the International Space Station. Astronauts can program in specific points of interest they wish to photograph, and T-10 will alert them shortly before the Station is set to fly over that location, if the current weather permits photography. The app can also alert astronauts to interesting weather phenomenon and potential upload photos directly to Twitter. Developed by a team in London, UK and licensed under MIT.

People's Choice: The solution that received the highest number of public votes.
Name/description of winner

ChicksBook (Space Apps Sofia)
ChicksBook is a functional web, Android and iOS application which can help you learn how to raise chickens and manage the data for your own backyard farm. Developed by a team in Sofia, Bulgaria and licensed under GNU general public license.
In the spirit of open innovation, all solutions are submitted under an open source license and available online for public access. These contributions are built with open data and are intended to be offered freely back to the world for use in different communities and contexts. Some solutions will be adopted as is, some will be encouraged forward into ongoing development, some will be "forked" for different applications. All will add value to the open source community and continue to inspire participation in human exploration.

This is where an innovative way of doing business becomes so critical: traditionally, government procures work via contracting, a complicated system that prescribes the result and often requires a long timeline. Mass collaboration facilitates agile iteration, vital innovation, and rapid prototyping – with all processes and products openly available. It is a radical shift of mindset and an unprecedented opportunity for government.

The solutions demonstrate what is possible when we see the world without borders, and put aside our differences in order to come together to collaborate, dream big and imagine endless possibilities that have lasting impacts on the world. Space Apps proves the vitality of allowing others to engage in our collective bigger story – one that has led us to the moon, to great observatories, and to humans living and working in space. It is a tangible example of how a government agency can think differently and build bridges across borders in order to help make lives better in tangible, concrete ways.

At NASA, we are rethinking what this means for how we manage our innovation process. We are embracing openness as a catalyst to innovation and providing unprecedented access to our raw data, software, and technology to a wide base of potential contributors. We are building better platforms and systems to aggregate and focus the collective contribution to our unique challenges. We are also shifting away from purely competitive approaches and embracing new paradigm-shifting collaboration. Because of this shift, we are enabling breakthroughs to break faster than was possible before. It's an exciting time to be working at NASA.

FUTURE PLANS

Based on the contributions of over 9,000 people around the world on Earth Day 2013, NASA's data is more accessible; renewable energy is contextualized and shared with the people who need it; NEOs can be more easily observed, tracked, and visualized; underwater vehicles can be remotely operated over the Internet; auroras can be aligned to crew stellar imagery; citizens used modeling to predict water contamination; teams gathered global stories of why we explore and advanced concepts for deployable greenhouses. We've visualized intracranial pressure data for astronauts, planetary water resources from space, NASA's impact on the economy – and much more. The results already have global impact and significance. We are extremely proud of the trailblazing accomplishments of everyone who participated over the 83 hours at the 2013 International Space Apps Challenge, and we are now setting our sights on even more distant horizons.

CHAPTER FIVE

FUTURE PLANS

The International Space Apps Challenge is a model for innovation that any government agency or institution can use for their own challenges, in their own context.

The solutions themselves may be spectacular, but the end result is much more than just the amazing technology created. It's the inspiration someone discovers when he connects with dust storms on Mars using an app like Sol, or when the Feel the Moon Kinect app users sense the moon's gravity themselves. We will be applauding these successes far into the future.

It is clearer than ever that the landscape of public engagement is now radically different, and technology has enabled the distribution of ideas, processes, and responsibilities in a way that facilitates unprecedented innovation. The future will be defined by you. You are the one who will create new technologies, develop new capabilities, and increase the knowledge and understanding of the fragile world on which we live.

What took place at the 2013 International Space Apps Challenge will send huge ripples through our space program. NASA's role has historically been crucial in seeding the technology and innovations that brought our nation's capabilities to the cutting-edge, made America the world's leader in space exploration, and have made a difference in our lives every day. This weekend demonstrated the true potential of participatory exploration and what can happen when a government agency like NASA takes a chance on engaging the untapped,

unexpected, and uncharted know-how of thousands of passionate citizens around the world. The event was not just about inspiring the next generation of explorers, but about inspiring today's scientists and engineers – all those brilliant rocket scientists who temporarily put their dream to work for the space program on hold for whatever reason, and are ready and willing to contribute if someone would just ask them.

Investments in innovative approaches to doing business differently, like those modeled at the 2013 International Space Apps Challenge, are required to maintain the agency's leadership position on the cutting-edge, while stimulating our economy and global competitiveness and inspiring future generations. If we are to truly achieve our highest potential, create new opportunities, and enlarge our understanding of our planet and our universe, we need to take a risk and think differently.

Finally, a note to all those who participated in the International Space Apps Challenge. We have achieved so much together, and that would not have been possible without your hard work, creativity, and expertise. We hope your experience not only expanded your knowledge of the cosmos, but that it inspired you to think bigger. If you discovered or re-ignited a passion during the event, please do something with it it – even if it's simply inspiring others around you to get involved in their space program. Don't wait for NASA or your space agency to create an opportunity for you. The future is for innovators, and we want to see what you will create!

Going forward, we are committed to truly catalyzing participatory exploration and to engage every person on Earth. This event directly impacted the lives of 9,147 of you. That's 0.00000131163% of the world population…which is a great start. But we believe our greatest work is still ahead of us, and we look forward to continuing our work to reach that other 99.99999869%!

OUR FUTURE IS BRIGHT AND WE ARE MORE READY THAN EVER TO TACKLE THE GRAND CHALLENGES OF TOMORROW.

The appendices highlight the locations, the challenges and some great examples of solutions developed at Space Apps 2013.

A ..... *List of locations*
B .....*List of challenges*
C ..... *List of top 36 solutions*
D ..... *List of partners*

LIST OF LOCATIONS

LOCATION	VENUE
Abu Dhabi	ADWEA Complex
Adelaide	Hackerspace Adelaide/ANZ Innovyz START
Allen Park	TechShop Detroit
Amsterdam	TMG Online Media
Athens	Hackerspace.gr
Atlanta	Big Nerd Ranch
Auckland	AUT University
Augusta	theClubhou.se
Azua de Compostela	City Council Azua de Compostela
Bangalore	Centre for Internet and Society
Barcelona	Strawberry SDK
Bilbao	IDEATECA
Bogotá	Edificio Murillo Toro MinTIC
Brisbane	The Cube: QUT
Canberra	Australian National University Advanced Instrumentation and Technology Centre
Cleveland	Advanced Technology Training Center
Contonou	EtriLabs
Cuilacán	Techsoft
Exeter	Met Office
Glasgow	University of Strathclyde
Gothenburg	Lindholmen Science Park
Guadalajara	ITESM Campus GDA
Guatemala City	CampusTec
Guayaquil	Universidad Santa María
Ho Chi Minh City	mLab East Asia
Houston	Rice University
Ifrane	Al Akhawayn University

LIST OF LOCATIONS

LOCATION	VENUE
Istanbul	Base Istanbul Hackerspace
Jakarta	Freeware
Kampala	Outbox Hub
Kansas City	Ingenology
Kathmandu	Direction Exhibition & Convention Center
Kennedy Space Center	Center for Space Education at The Astronauts Memorial Foundation
Krakow	Google for Entrepreneurs Krakow
La Paz	Universidad La Salle
Lausanne	EPFL - Swiss Institute of Technology
Leicester	LCB Depot
Limassol	Cyprus University of Technology
London	Google London
Louisville	Jefferson Community and Technical College
Madrid	Madrid International Lab
Managua	Universidad Americana
Manila	Dungeon Innovations
Melbourne	Victorian Space Science Education Centre
Mexico City	Sociedad Astronómica de México
Monterey	IOS Offices
Nairobi	iHub
New Delhi	New Delhi
New York	AlleyNYC
Norman	University of Oklahoma
Panamá	FIEC Universidad de Panamá
Paris	La Cantine
Philadelphia	The ExCITe Center at Drexel University
Port-au-Prince	Ecole Supérieure d'Infotronique d'Haïti
Pretoria	mLab Southern Africa
Puunene	MauiMakers
Recife	Porto Digital

LOCATION	VENUE
Reno	Reno Collective
Rochester	RIT Simone Center for Student Innovation and Entrepreneurship
Rome	La Sapienza, Department of Engineering
Round Rock	TechShop
Saint-Louis	Ndar Numérique
Salisbury	hotDesks.org
San Francisco	Lemnos Labs
Santa Cruz	Centro Boliviano Americano
Santa Marta	CETEP
Santiago	Universidad Técnica Federico Santa María
Santo Domingo	INTEC
Singapore	Microsoft
Skopje	Seavus
Sofia	Telerik Academy
Syracuse	Syracuse University School of Information
Tallahassee	Making Awesome
Tampere	New Factory
Tokyo	University of Tokyo Center
Toronto	Royal Ontario Museum
Toulouse	La Cantine Toulouse
Valencia	Universidad de Carabobo
Virtual	Virtual Participation
Winnipeg	University of Manitoba
York	The University of York

LIST OF CHALLENGES

"No Delays" Air Traffic Management

#nodelays

http://spaceappschallenge.org/challenge/no-delays-air-traffic-management

Current air traffic operations include about 50,000 operations per day, but most people aren't aware of the problems that plague the current system. Let's give the public a better understanding of those inefficiencies and bottlenecks, and help NASA's Airspace Systems Program increase the capacity and efficiency of air traffic operations while reducing costs. Create a gaming and technology crowd-sourced development platform to evolve the best ideas for future air traffic management. Key functions include but are not limited to flight planning, scheduling, airport surface movement, rerouting airborne aircraft based on weather and winds, and efficient arrival/departure planning from gate to gate. This platform could be used by high school and college students, new companies, business schools, and of course NASA.

"Catch a Meteor" Tracker

#catchameteor

http://spaceappschallenge.org/challenge/catch-a-meteor-tracker

The meteor crash seen 'round the world in February 2013 over Chelyabinsk produced meteorites with a mass of over 1 kg, and re-awakened a worldwide curiosity in Near-Earth Objects (NEOs). Create a meteor-tracking app, game, or data visualization to educate people about the science of NEOs, the likelihood of encounters with objects of various sizes, and the discoveries that are made by studying these rocky visitors to our planet.

Aligning the Stars

#alignthestars

http://spaceappschallenge.org/challenge/aligning-the-stars/

Do you love jigsaw puzzles? Do we have a puzzle for you! Align thousands of frames of time lapse photography that the ISS crew have taken of aurora and other features with star fields visible in the background. Identifying the star fields will enable creative displays of the imagery and also “fit” it into the puzzle of the aurora ring. Scientists can then use that imagery for studying the aurora and its impact on Earth. Create an app to match and align the stars in the aurora imagery taken from the ISS. Using the stars, the nadir point (spot over the Earth), and the altitude of the ISS when the image(s) was taken, overlay and display the aurora in context with the NOAA aurora oval for that day and time.

ArduSat

#ardusat

http://spaceappschallenge.org/challenge/ardusat

Don’t tell us you haven’t always wanted your own satellite. ArduSat is the world’s first open Space network, offering you the chance to control a satellite. It’s equipped with 15 sensors on board, including a camera, spectrometer and Geiger counter. It also has a few Arduino Microprocessors onboard. Run experiments, games, applications, or whatever else you dream up. With all this functionality, we need people to push the envelope. Grab the onboard camera, computing power, and data culled from NASA satellites and the 100 million+ iPhones and Android phones in the world to showcase the influence of the Sun’s turbulent storms on Earth’s transportation network, power grids, and people. The potential for creativity and innovation here is quite literally out of this world.

Asteroid Hunter

#asteroidhunter

http://spaceappschallenge.org/challenge/asteroidhunter

Apophis is a near-Earth asteroid that caused a brief period of concern in December 2004, because initial observations indicated a probability of up to 2.7% that it would strike the Earth in 2029. Apophis broke the record for the highest level on the Torino Scale for asteroid impact hazard, being, for only a short time, at level 4, before it was lowered. On average, an asteroid the size of Apophis can be expected to impact Earth about every 80,000 years. Using more recent observations and calculations, the threat of impact from Apophis in the years 2029 and 2036 has been eliminated. However, astronomers and mission planners continue to monitor the asteroid to calculate potential future close encounters. Develop a mission concept to explore Apophis to better predict its orbital dynamics and to instrument the object with a radio transponder prior to the 2029 close approach.

Backyard Poultry Farmer

#backyardfarm

http://spaceappschallenge.org/challenge/backyard-poultry-farmer

People everywhere are raising poultry in their backyard. Some raise birds to have a steady supply of fresh eggs, some as part of their commitment to eating locally, some to sell eggs to their friends and neighbors at the local farmers market. For the past six years, the Animal and Plant Health Inspection Service's (APHIS) Biosecurity For Birds

campaign has been reaching out to new—as well as seasoned—backyard poultry owners to provide tips and advice on how to prevent diseases, like different strains of avian influenza, from reaching their birds. Create a Backyard Poultry Farmer app with the objective of getting individuals and households back into local agriculture.

Bootstrapping of Space Industry

#moonville

http://spaceappschallenge.org/challenge/affordable-rapid-bootstrapping-of-space-industry

On any given clear night, people have the opportunity to look up at the Moon and wonder. How hard would it be to establish some presence on the Moon? Could we do it? Why should we? What resources does the Moon have that could support an industry? Develop a simulation of a lunar industry through a series of "bootstrapping" stages until it becomes self-sustaining. Strategize which machines to build first and how many of them, using resources launched from Earth and available from the Moon. A major part of this challenge is learning what the purpose and value of a lunar industry could be and incorporating it into the game.

Comparing Earth Landscapes

#earthlandscapes

http://spaceappschallenge.org/challenge/comparing-earth-landscapes-with-planets-and-moons

Part of sending a robotic or manned mission to another planet is finding ideal places to land. To do that, scientists compare different landscapes on Earth with those of other planets and their moons, or other bodies, like asteroids. Finding close matches can benefit scientists and astronauts in preparing to send a probe or even manned missions by first practicing here on Earth. Help them by creating an application that allows the user to compare Earth landscapes with planetary surfaces, like

the moon, Mars, Mercury, Ceres, or Vesta.

CubeSats for Asteroid Exploration

#cubesats

http://spaceappschallenge.org/challenge/cubesats-for-asteroid-exploration

CubeSats are tiny, approximately 4”x4” satellites that can conduct space research using readily available, off the shelf hardware plus one of a variety of propulsion devices. So far CubeSats can only reach low-Earth orbit (LEO), but the potential to reach other celestial bodies is there. Imagine if a small student group could send an experiment to Saturn. Or a private company could use one to explore an asteroid for minerals. Or an amateur space exploration club could take the first images of a newly discovered comet. Help them get there. Develop a website that publicizes potential interplanetary destinations for CubeSat missions and available launch opportunities. Or come up with new ways to use CubeSats, such as developing a cubesat-based sensor package that can be used to impact an asteroid and send back information about the minerals inside.

Curiosity at Home

#curiosityathome

http://spaceappschallenge.org/challenge/curiosity-at-home

If you haven’t seen the “7 minutes of terror” video by now, stop what you’re doing and watch it: http://www.youtube.com/watch?v=Ki_Af_o9Q9s. Curiosity is one of the most connected missions in history: more than 3.2 million people watched the nail-biting descent of the Curiosity Rover live

onto the Red Planet, and 1.2 million people regularly follow Curiosity's adventures via Twitter. We're all hungry for Curiosity updates. How can we connect people at home to what's happening with the rover? Foster a connection between citizens and the rover through software, visualizations, or a remote or app-controlled "home rover" that connects people to Mars and the Mars Rover, educating them and encouraging Mars enthusiasm.

Dark Side of the Moon

#darksideofthemoon

http://spaceappschallenge.org/challenge/democratization-of-the-dark-side-of-the-moon

NASA's first manned mission to the moon was in the summer of 1969, so you'd think we'd have every detail mapped out. But did you know the first video of the far side of the moon was beamed back to Earth as recently as January 2012? If you didn't, you're not alone. Use 3D vector data and raise awareness of and encourage interest in the far side of the moon using available images and data via web applications and 3D-printed objects.

Database of Near Earth Objects

#NEOdatabase

http://spaceappschallenge.org/challenge/citizen-generated-database-near-earth-objects

Some of the best near-Earth object (NEO) discoveries have come from citizen astronomers with off-the-shelf telescopes. NASA and the great space research community receive reports of new objects every day. By leveraging the citizen astronomy community to centrally report and help vet these observations, scientists would be able to more effectively research and track Near Earth Objects. Create an app or web-based platform that enables citizen astronomers to register, submit findings, and help rank the findings of other citizen astronomers. Findings that receive many positive rankings will be listed on a “potential candidates” list for new discoveries. Wherever possible, the tool should integrate with existing resources, such as the Minor Planet Center, which offers tracking of potential candidates.

Deployable Greenhouse

#deploygreen

http://spaceappschallenge.org/challenge/deployable-greenhouse

For prolonged manned missions to the Moon or Mars, freeze dried foods get old really quickly. That's why scientists are researching regenerative life support systems, such as greenhouses, that produce food on the planet's surface. The trick is, these structures must be able to be delivered, deployed, operated, and maintained in extreme environments. Develop a conceptual design of a deployable greenhouse that could be used for pre-deployment on a space mission to the Moon or Mars.

Earth Day Challenge

#earthday

http://spaceappschallenge.org/earth-day-challenge

The International Space Apps Challenge is planned close to Earth Day for a reason: from the beginning of humans collecting it, space data has helped us here on Earth. Since the first Earth Day in 1970, many pollution problems have vastly improved, such as water pollution in the Great Lakes and air pollution in Los Angeles. But others have significantly worsened, like CO2 emissions and ozone depletion. We need better visuals of pollution as we continue to face its major challenges. Help us visualize it! This visualization can take a number of forms: a poster, a map animation, an interactive data visualization for the web or mobile phones, or anything else you can imagine. Ideally it will span from 1970 to the present. You can also be creative with your visualization and the data you use. Just remember this theme: "What can you do to help celebrate Earth Day and show how space data and other data can help save the planet?"

LIST OF CHALLENGES

Earth From Space

#earthfromspace

http://spaceappschallenge.org/challenge/earth-from-space

ISS (International Space Station) Earth-KAM (Earth Knowledge Acquired by Middle school students) is an educational outreach program sponsored by NASA that allows middle school students from around the world to capture images of Earth from a digital camera on board the International Space Station. What we need is an easy way for people to interact with these images. Create an educational application that allows users to overlay EarthKAM images on a 3D model of earth, annotate and comment on the images, and share their work via social media. This application can be web-based or designed as a mobile application for an Android device.

EarthTiles

#earthtiles

http://spaceappschallenge.org/challenge/earthtiles

Mapquest's open aerial tiles have proven extremely popular with web developers for exposing satellite imagery of Earth in Leaflet, OpenLayers, and other mapping libraries. Tiles are a popular way to distribute a large amount of geo imagery that can be put in to a standard map. For instance, the front page of spaceappschallenge.org is a Leaflet map! Take global imagery data from Landsat, EOS, Terra, and other missions and turn them into tiles that can be used in an open source street map. This would enable incredible amounts of visualization and contextual data narration, especially if such

tiles were able to be updated on a regular basis as new data is released.

Exploring Asteroids: Planet Hopper *#planethopper*

http://spaceappschallenge.org/challenge/exploring-asteroids-planet-hopper-20

Small-Body Database at the Jet Propulsion Laboratory provides information on a number of small objects (like asteroids) in the solar system. However, actually contextualizing and understanding this data for non-scientists is difficult. Improve the "Planet Hopper" project from Space Apps 2012, and adapt it for use with small body space objects.

For the Record *#fortherecord*

http://spaceappschallenge.org/challenge/for-the-record

NASA's office of Education is looking for a new way to collect and analyze data on its programs. Capturing and understanding feedback and response to educational activities, materials, and engagement helps with program development, analysis and evaluation cycles/efforts. Current methods for determining participant responses include, surveys, focus groups, exit interviews and informal discussions. But these methods are costly, biased, deemed burdensome, and challenging to implement. In order for NASA to have a more active (as opposed to reactive) response regarding our investments we must receive unbiased and timely feedback. Develop web-based or mobile platform through which users can provide NASA Education feedback on their experience. The initial audience here is for interns at the NASA Education program.

and challenging to implement. In order for NASA to have a more active (as opposed to reactive) response regarding our investments we must receive unbiased and timely feedback. Develop web-based or mobile platform through which users can provide NASA Education feedback on their experience. The initial audience here is for interns at the NASA Education program.

Hitch a Ride to Mars

#ridetomars

http://spaceappschallenge.org/challenge/hitch-a-ride-to-mars

What can CubeSats do? More like what can't they do. They have proven to be a very cost-effective and useful platform for low-cost and simple experiments in Earth orbit, and do so in a non-interference basis to the primary payload. NASA has successfully launched and utilized CubeSats in the past, including the historic December 2012 deployment from the International Space Station. But there are so many more more ways we could use them (Mars exploration, for starters). Create a CubeSat design and develop a mission that operates in the Mars environment and furthers our knowledge of Mars. The result could take many forms: a simple mission concept document, software for CubeSat hardware and sensors, a detailed CubeSat design, a full mission plan, or prototype CubeSat hardware for example.

In the Sky with Diamonds

#diamondplanet

http://spaceappschallenge.org/challenge/in-the-sky-with-diamonds/

The Atlantic calls it the stuff of James Bond movies: approximately 40 light years from Earth in the Constellation of Cancer orbits the extrasolar planet 55 Cancri e around the Sun-like star 55 Cancri A. The planet's mass is about 7.8 Earth masses and its diameter is about twice that of Earth's, thus classifying it as the first Super Earth discovered around a main sequence star. We've known about this planet since 2004, but recently scientists discovered 55 Cancri e is mostly diamond! So, there's a Super Earth out there that is basically a giant diamond. To help spread the word, design a piece of jewelry or wearable art that celebrates this planet's unique qualities. Could be analog or digital jewelry, perhaps with an Arduino or GIS feature.

Incentives Tied to Utility Rates

#utilityincentives

http://spaceappschallenge.org/challenge/mobile-incentives-tied-to-utility-rates

There is a lot of data that is openly available to aid in consumer decision-making, including many energy-saving smartphone apps. However, the majority of those apps provide information on available incentives, tax credits and rebates. While this data and research is good for experts in the field who understand how to navigate valuable resources, the data is not readily accessible to most consumers, particularly as reliance on smartphones increases for informing on-the-spot decisions. Inform consumer's decisions by providing them via mobile interface actionable information about energy efficiency methods, available incentives, applicable policies. This way, a homeowner in Florida could spend a few minutes at Home Depot reviewing home energy efficiency recommendations and rebates that would reduce the cost of a dishwasher.

LIST OF CHALLENGES

International Print Station

#ISSprints

http://spaceappschallenge.org/challenge/hitch-a-ride-to-mars

A 3D space printer, or “International Print Station,” makes it possible to print, manufacturer, farm, maintain and repair a wide array of constructs, big and small--from space. What could you do? Create an application that can be used to print or manufacture constructs inside a geostationary 3D print station.

Kennedy Space Center 2040

#KSC2040

http://spaceappschallenge.org/challenge/envision-kennedy-space-center-spaceport-2040/

Though the Space Shuttle program ended in 2011, Kennedy Space Center’s 140,000 acres are still of immeasurable use for decades to come. Design a concept of the Kennedy Space Center Spaceport in 2040, using the spaceport’s current state as a starting point. Show government and commercial facilities for: orbital launch, suborbital launch and processing. Include the required community planning of research parks, tourism, and supporting infrastructure (transportation, hotels, etc.).

Lego Rovers

#legorovers

http://spaceappschallenge.org/challenge /lego-rovers

As part of its Science, Technology, Engineering and Mathematics (STEM) Ambassador program, Computer Science at the University of Liverpool has developed a simple application on a Lego Robot which can be taken to school science clubs and similar events and driven from a laptop. Experience taking the Lego Rover into schools suggests students are particularly engaged by the

ability to easily experiment with changes to the robot's behaviour without the need to program something up from scratch (as is necessary with an off-the-shelf Lego Mindstorms system). They are engaged enough with the robot that they will spontaneously devise their own questions and "experiments" about the system behaviour they hope to test. Design a remote operation system to control a Lego Robot through a computer or smartphone. The goal of this system is to help make the Lego Robot more entertaining, educational, and accessible to students and teachers, all while serving the Lego Robot's goal in demonstrating the unique challenges facing the remote operation of planetary rovers and how increased robot autonomy can help address such challenges.

LIST OF CHALLENGES

Listening to the Stars

#listentostars

http://spaceappschallenge.org/challenge/listening-to-the-stars

Most of us can't see or 'touch' space - but we often can hear it, and the speed of sound means we are often hearing events that happened long ago and far away. You can witness the orbits of Sputnik, the landing on the moon or even the Big Bang... where space is "leaking in" to the pipes and taps of our more ordinary world. Listen to some of the space sound clips provided in the Resources section of this challenge, then try to create those sounds by using real world objects. Or, using electronics, create real world objects that playback some of those sounds.

More Earth Observation

#moreEarthpls

http://spaceappschallenge.org/challenge/more-earth-observation

For various reasons ranging from security issues to cloud cover, there are still many places on Earth for which we don't have satellite images or for which there is an untapped demand for more satellite-based information. Knowing where these gaps are would help with seamless coverage of the Earth. The Satellite Applications Catapult challenge is to find a solution to promote and help worldwide users to spot world locations not covered by satellite images and to formulate requests for satellite images and related information on certain locations. You can develop a crowd-sourced preferential pointing of satellites, based on demand, or help to fill gaps in Earth Observation and image databases.

My Space Cal

#MySpaceCal

http://spaceappschallenge.org/challenge/my-space-cal

We have a wealth of astronomical satellites from various organisations circling around the Earth staring at numerous astronomical targets. But at any given time, where exactly are they looking? Each satellite project has its own devoted time schedule retrievable from the web, giving information about observations done in the past, observations foreseen in the near-future (i.e., short-term), and observations foreseen in the far future (i.e., long-term). All have different ways and styles to retrieve and display the schedules. This makes it extremely cumbersome to see what a satellite is observing or did observe at a given time or will observe in the future; comparing schedules from different satellites is even harder. Combine the past and future time schedules of satellites into a common calendar and make the information easily accessible. This can be done as an app or a website.

My Virtual Mentor

#virtualmentor

http://spaceappschallenge.org/challenge/my-virtual-mentor

NASA GIRLS (Giving Initiative and Relevance to Learning Science) is a virtual mentoring program using commercially available video chat programs to pair mentors at NASA with middle school girls across the United States. The program gives young girls the opportunity to interact and learn from real engineers, astronauts, scientists, and technologists and inspires them to contribute to science, technology, engineering, and math. They work together for five weeks in the summer on pre-defined, web-based projects. We want to expand the NASA GIRLS program's online presence to mobile or tablet platforms, or both, so every girl can access the program from wherever she is.

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NASA Wind Tunnel Visualization

#windtunnels

http://spaceappschallenge.org/challenge/nasa-wind-tunnel-visualization

Are you a spreadsheet whiz? Do you eat charts and infographics for breakfast? Then NASA's Aeronautics Test Program (ATP) has a challenge for you. ATP runs 12 wind tunnel test facilities and is charged with creating a "super graphic" to visualization utilization data and trends for each facility. They're looking for a fresh visualization to replace their current Microsoft Excel sand chart. Create one or more visualizations of ATP facility usage data using a supplied spreadsheet.

NASA's Impact on the Economy

#NASAeconomy

http://spaceappschallenge.org/challenge/how-does-nasa-impact-the-economy

NASA tackles the big stuff, but everyone should know the answer to one of the basic questions: "what's in it for me?" Everyone should easily be able to find how a NASA action impacts their communities. NASA has publicly accessible data that provides information on jobs, dollars spent, and likely many other data points that would help in communicating the economic impact that

NASA is making across the United States (possibly the world). The problem is that all these data are located in different places and are not easily accessible. Help communicate NASA's economic impact through an app, visualization, or other interactive media.

Off The Grid

#offthegrid

http://spaceappschallenge.org/challenge/off-the-grid

Sustainability is achieved by balancing the need for economic vitality, environmental stewardship, and social responsibility to ensure that we have enough resources to meet our needs today and in the future. Too many people aren't living sustainably enough to maintain an environment future generations can inhabit. "Getting off the grid" refers to living in a self-sufficient manner without reliance on any public utilities. But how do you get off the grid? Create a website, app, or visualization to help people learn about and share resources for off-the-grid living.

OpenROV

#openROV

http://spaceappschallenge.org/challenge/open-rov

OpenROV is a DIY telerobotics community centered around underwater exploration and education. The remotely operated vehicle (ROV) is a low-cost telerobotic submarine that can be built with mostly off-the-shelf parts. This way, anyone can explore and study under-water environments. The OpenROV community is also laying the foundation for globally-connected citizen scientists to share their data and findings. Design and test an interface that allows control of an OpenROV from distance of more than 50 miles away.

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Peace Corps Orbital Perspective

#peacecorps

http://spaceappschallenge.org/challenge/peace-corps-orbital-perspective

The Peace Corps traces its roots and mission to 1960, when then Senator John F. Kennedy challenged students at the University of Michigan to serve their country in the cause of peace by living and working in developing countries. Since then, over 210,000 volunteers have served in 139 host countries to work on issues ranging from AIDS education to information technology and environmental preservation. Today's Peace Corps is more vital than ever, working in emerging and essential areas such as information technology and business development, and contributing to the President's Emergency Plan for AIDS Relief. Create a visualization of the global reach of Peace Corps projects and volunteers using any form: a poster, a map animation, an interactive data visualization for the web or mobile phones, or anything else you can imagine.

Predicting Water Contamination

#mWater

http://spaceappschallenge.org/challenge/predicting-water-contamination/

mWater has created a mobile app and global database of water sources. The app makes it easy to add new water sources, record the results from inexpensive water quality tests, and perform surveys. We also recently created a similar app/database of sewage flows into the environment called mSewage, which is now a finalist for the Sanitation App Challenge. We would like to add capabilities to the mWater app to display data from remote sensing products. Possibilities include: boundaries of water bodies, population density, and digital elevation models. These could be combined with water body boundaries to generate maps of areas that are vulnerable to fecal contamination because the are downstream from pollution sources tracked using the mSewage database.

Reach For the Stars

#reachforthestars

http://spaceappschallenge.org/challenge/reach-stars

On August 28, 2012, a song was beamed back to Earth from another planet for the first time in history. Students, scientists, and officials at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California gathered for the premiere of will.i.am's latest track "Reach for the Stars" after it was transmitted from Mars by the Curiosity rover. The song is part of a larger initiative through his i.am.angel Foundation to inspire young people to cultivate their interests in STEM (Science, Technology, Engineering, and Math). How do we get more kids interested in science and space exploration? will.i.am and his i.am.angel Foundation challenge you to create an app for kids, to inspire more youth participation in space exploration, and to encourage the development of STEM skills.

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Reading by Starlight

#readbystarlight

http://spaceappschallenge.org/challenge/reading-by-starlight

Almost everyone loves to watch the stars. What if you could read or watch the rest of your life by the stars? Regardless of weather or location, if you go high up enough, you can always see stars. Let's let the data shape what we can see by them. Create a virtual tour of the star maps produced by the Kepler telescope. You may also create something different that generally promotes engagement with the Kepler telescope.

Reel Inspiration

#reelinspiration

http://spaceappschallenge.org/challenge/reel-inspiration

We believe in the power of stories that can inspire girls everywhere to reach for the stars and explore the myriad opportunities available to them by pursuing careers in science, technology, engineering, and mathematics. Create videos of young women and girls around the world sharing their own stories related to science, technology, engineering and math. Explore ways in which these videos could be shared with the world.

Renewable Energy Explorer

#energyexplorer

http://spaceappschallenge.org/challenge/ renewable-energy-explorer

For people to make good decisions about renewable energy, they need convenient access to information about the resource potential in their area. And it's not that people aren't curious: the data is available from various government websites, but it's often highly technical, not user friendly, or both. Create a simple web application or visualization, or smartphone app that spatially and temporally integrates wind, solar, and geothermal energy data and allows users to see where, on average, wind, solar, or geothermal potential are greatest.

Revitalize the PDS

#PDS

http://spaceappschallenge.org/challenge/revitalize-nasas-planetary-data-system

The Planetary Data System is an incredible resource to scientists around the world - but much of the data inside of it is difficult to use for non-subject matter experts. In 2012, the PDS Challenge created some of the most compelling solutions from the global event, including the widely acclaimed vicar2png software that revitalized imagery from previous NASA missions. The PDS contains data from dozens of NASA missions. Can you find interesting data sets and build tools to display, visualize, or translate them in new ways? Can the data be re-presented through flexible APIs, fed on to social networks, or turned in to interactive experiences? As part of this challenge, we ask you - the citizen scientists and developers of the world - what do you want out of the PDS?

LIST OF CHALLENGES

SciStarter Citizen Science

#SpaceMicrobes

http://spaceappschallenge.org/challenge/scistarter-citizen-science

A few citizen science projects are getting us excited: 1) We're going to swab surfaces inside the International Space Station (ISS) to investigate patterns in microbial communities. 2) We'll swab surfaces in buildings and all kinds of public events, including sporting events and space meetups, and compare those microbial communities to the ones in space. 3) We'll take impressive samples from Earth and send to space for the microbial playoffs…in SPAAAAACE! Help us with these projects by constructing software in three main areas: sample collection, progress tracking, visualization and analysis.

Seeing in Space

#spacevision

http://spaceappschallenge.org/challenge/seeing-in-space

NASA has known for some time that astronauts on long duration flights experience visual impairments due to intracranial pressure, some short-lived after flight, and some persistent. But study of this syndrome is relatively new, and we don't fully understand the causes. Create a visualization or model to help better understand intracranial pressure and its contributing factors. The solution should graphically represent the Visual Impairment/Intracranial Pressure (VIIP) data by creating a visualization color coded like a gene array.

Seeing Water From Space

#waterfromspace

http://spaceappschallenge.org/challenge/seeing-water-from-space

Water management and climate change are broad regional issues in South America with important implications for industrial activities, indigenous communities, as well as flora and fauna. This challenge seeks to enable macroscopic, or large scale, analysis of water resource conditions throughout the altiplano of Chile. Create a web map of Chile water resources, showing how they have changed over time and how their changes over time relate to changes in climate.

Seven Minutes of Science

#7minutesofscience

http://spaceappschallenge.org/challenge/seven-minutes-of-science

While landing on Mars, the Mars Science Laboratory (MSL) system ejected approximately 300 kg of inert mass to offset its center of gravity before atmospheric entry and then rebalance its center of gravity after atmospheric entry. This 300 kg might be used on future missions for Mars-related science and technology applications. Develop ideas for how NASA can turn extra available mass on a Mars mission into a scientific or technological payload. If you had 150 kg of ejectable mass prior to entry and another 150 kg during the entry and landing phase of a Mars mission, what would you do with it? You can take your solution further by developing a prototype to demonstrate its functionality. Past successful uses by NASA to apply the concept of using dead weight to accomplish scientific objectives include: Get Away Specials on Shuttle, EarthKam on ISS, and CubeSats on unmanned vehicles.

Skymorph Imagery API

#skymorph

http://spaceappschallenge.org/challenge/skymorph-imagery-api

SkyMorph provides access to optical images and catalogs generated by the Near Earth Asteroid Tracking (NEAT) program. You can find images by time and position or search by specific asteroid or other moving object. The time dimension, unique to SkyMorph, allows users to discover changes in the intensities of stars like supernovae, or to discover moving objects like comets. To help with this, you could develop an API that could enable developers and citizen scientists to programmatically access SkyMorph imagery using a RESTful interface. This would enable bulk querying as well as a variety of interesting possibilities around improving access to data. Or develop a Google Earth/Sky KML that would enable individuals to access SkyMorph imagery using the visual interface of Google Sky, providing a lower barrier of access to the data.

Smart Cities, Smart Climate

#smartcities

http://spaceappschallenge.org/challenge/seeing-water-from-space

The Birmingham Urban Climate Laboratory (BUCL) in the City of Birmingham, UK has recently created a network of over 200 air sensors across the city to explore the impacts of urban heat on health, infrastructure, and society. Due to the air sensors' low-cost and their ability to connect to existing networks, they can be easily set up in other cities across the world for global comparisons. Use existing data to explore and visualize

connections between environmental measurements and other local datasets, such as health or traffic accidents.

Soil Testing Kit

#soiltestkit

http://spaceappschallenge.org/challenge/soil-testing-kit

Crowdsourcing is increasingly being used to collect data for scientific research. Examples relevant to soils include the Tea Bag Index, for collecting information on the decay rates of carbon in soils (http://www.decolab.org/tbi/concept.html), the UK Natural History Museum's website for earthworm and soil surveys through the OPAL project led by Imperial College (http://www.opalexplorenature.org/soilsurvey), and the British Geological Survey's mySoil mobile app (http://www.bgs.ac.uk/mysoil/) for collecting basic soil properties in the UK. The Met Office Weather Observations Website (WOW) also crowdsources weather station data (http://wow.metoffice.gov.uk/). This crowd sourcing challenge involves designing user friendly and accessible guidelines for testing key soil parameters; experimenting with practical soil testing approaches and developing a simple means for users to feedback their soil measurements using web/ phone technology.

LIST OF CHALLENGES

Solar Flare

#solarflare

http://spaceappschallenge.org/challenge/solar-flare

Episodic solar activity has a number of fascinating effects. A radiation dose from energetic particles is an occasional hazard for astronauts and for electronics on satellites. Geomagnetic field disturbances may damage power systems, disrupt communications, degrade high-tech navigation systems, or create the spectacular aurora (Northern and Southern lights). Space weather can disrupt satellite operations, navigation, electric power, radio communications, geophysical exploration and much more. Create a physical or virtual representation of these invisible (to the human eye) phenomena that can affect so many vital terrestrial activities

Space Station Benefits to Humanity

#ISSforhumanity

http://spaceappschallenge.org/challenge/space-station-benefits-to-humanity

Studies have shown that sharing information about NASA technologies and the commercial products that have resulted from those technologies increases the public's appreciation for space exploration. We call these technologies "spinoffs" and NASA has a publication of the same name aimed at sharing information about the benefits of NASA technologies (http://spinoff.nasa.gov/spinhist.html). A few years ago, the NASA City and Home application was launched to deliver a visually appealing and interactive way for the public to navigate a city or home to see where NASA benefits their daily lives, but it could use an update. This information

is now available for the International Space Station (ISS), too (http://www.nasa.gov/pdf/626862main_ISS_Benefit_for_Humanity.pdf). Develop a tool to improve the understanding of the incredible benefits that International Space Station is delivering back to Earth.

Spot the Station

#spotthestation

http://spaceappschallenge.org/challenge/soil-testing-kit

NASA launched the Spot the Station website (http://spotthestation.nasa.gov) on November 2 and was immediately a hit with 100,000 viewing the site in just five days and 250,000 in a few weeks. The site allows you to spot the space station and sign up for alerts when it flies overhead. Extend the functionality of the Spot the Station site by building an app that allows you to share your sightings with others. Create a visualization with Spot the Station data.

Syncing NASA Open Source Projects

#NASAoss

http://spaceappschallenge.org/challenge/syncing-nasa-open-source-projects

Currently, NASA's Open Source projects live in a variety of formats across the internet, such as repositories on GitHub or Sourceforge or tarballs stored on NASA servers. NASA's GitHub presence is designed to be a central place for members of the public to access these projects. We would like, however, to keep many projects in their original homes and mirror them to github.com/nasa. Create an application that runs on a server or PaaS like Heroku and watches git or svn repositories as well as static files for changes, then mirrors those changes to http://github.com/nasa. This has a variety of uses, including open source mirrors for archival purposes, synchronizing multiple disparate assets, and so on.

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The Blue Marble

#bluemarble

http://spaceappschallenge.org/challenge/the-blue-marble

Probably the most famous photo taken of Earth from space is the iconic Blue Marble, taken on December 7, 1972, by the crew of the Apollo 17 spacecraft, at a distance of about 45,000 kilometres (28,000 mi). But many people don't know it wasn't the first—that one was taken on October 24, 1946, from an altitude of 65 miles above the surface of New Mexico, captured by a 35-millimeter motion picture camera as that camera was propelled skyward on a German V-2 missile. Since spaceflight began, millions of photos have been taken of Earth from space, many of these images are never seen by a wider audience. Create an app, platform or website that consolidates a collection of space imagery and makes it more Gravity Recovery and Interior Laboratory (GRAIL) is NASA's first planetary mission with instruments fully dedicated to education and public outreach. While the twin GRAIL satellites orbited the Moon to learn more about its gravity and interior composition,

Tour of the Moon

#tourthemoon

http://spaceappschallenge.org/challenge/tour-of-the-moon

MoonKAM (Moon Knowledge Acquired by Middle school students) gave students a unique opportunity to snap their own images of the Moon's surface using cameras on board the spacecraft. It is led by Sally Ride Science—the science education company founded by Dr. Sally Ride, America's first woman in space—in collaboration with undergraduate students at the University of California, San Diego. Create an application for the Web and/or an Android mobile device (or other open-source mobile platform) that will allow anyone to take an interactive tour of the Moon. Overlay MoonKAM images onto 3D-generated lunar topography using available information. Once the image is displayed on the Moon model, identify the lunar features in the image, such as craters, lunar landing sites, and other unique locations.

We Love Data

#welovedata

http://spaceappschallenge.org/challenge/we-love-data/

There is a certain thrill that you feel when you know that you are connected to something. From our earliest use of technology to synchronise and connect our communities we have used simple interactions to inform people. A bell from a place of worship to call people to prayer, or a siren to warn of danger, a phone ringing or a doorbell chiming - these indicators all provide connections to something bigger than us. Something that is about to happen. Something that we connect to. What if we had the same kind of thing to tell us that the International Space Station is overhead, a solar storm has exceeded a threshold, or that in space it is very very cold? Can we use simple physical interactions to connect us to data? Can we wear data? Or build jewellery that connects data to our skin? Can we adorn and decorate our lives with

data from space? The possibilities are endless. Show us one way to encourage people to interact with space data in new and meaningful ways, in effect promoting space enthusiasm, education, and a stronger human community.

Why We Explore

#whyweexplore

http://spaceappschallenge.org/challenge/why-we-explore

You hear a lot about the how and what of NASA operations, but very rarely do you hear about the the "why" in an easily accessible, compelling visual. Tell the "why" of space exploration through the creation of compelling narratives and visualizations of the stories and data from NASA's history. The best entries will go on the Why Explore Space page.

Wish You Were Here

#wishyouwerehere

http://spaceappschallenge.org/challenge/wish-you-were-here

One of the first things anyone does before traveling is check the weather. Space explorers need the same thing! Develop an engaging representation of weather on Mars. The idea is to translate scientific weather data into a graphical representation for the layperson, similar to the way earth weather apps do the same. This can take multiple forms: an app, a physical object, or a visualization.

57 TOTAL CHALLENGES

The full list of challenges with data can be found at
spaceappschallenge.org/challenges

LIST OF SOLUTIONS

Best Use of Data

The solution that best makes space data accessible or leverages it to a unique purpose / application.

Sol

Sol is the world's first interplanetary weather application. Rather than viewing the weather by inputting a zip code, users can select a planet and view the weather there. The Sol team also built the MAAS API, used to fuel several of the Mars weather applications produced at the Space Apps Challenge. Developed by a team in Kansas City, Missouri and licensed under the MIT license.

Space Cal NYC

SpaceCalNYC plots space-based telescope observations against a beautiful image of our galaxy, lets visitors click targets to get additional details, and links to images when available. It provides a calendar-style listing of observations; the data can be filtered by date, observed object, or observing telescope. The database is updated daily. Finally, if text files are your thing it lets you export observations as plain text. Developed by a team in New York City, New York and licensed under the MIT license.

EarthKAM Explorer

EarthKAM Explorer provides web-based 3D visual exploration of satellite images taken by middle school students through the ISS EarthKAM program. EarthKAM Explorer supports the Leap Motion controller for hand-gesture input. It is written in JavaScript using

Cesium, an open-source WebGL virtual globe and map, so it runs in a browser without a plugin. Developed by a team in Philadelphia, Pennsylvania and licensed under Apache.

OpenTiles

OpenTiles is a service for web developers that allows for a variety of NASA imagery to be embedded in a Google Maps-like interface powered by OpenLayers or Leaflet. Additionally, the tiles support a variety of formats, enabling layering of different datasets, expanded mapping, and GIS functionality on top of existing NASA earth science data. Developed by a team in Tallahassee, Florida and licensed under MIT.

SpaceHub

SpaceHub is a hosted source management service that simplifies the management of projects. Project administrators can mirror projects stored in various version control systems into one central GitHub account without having to migrate the projects from their original locations. Runs on OpenShift Express. Developed by a team in Rochester, New York and licensed under the GNU general public license.

Big Marble

The Big Marble takes NASA's amazing Earth imagery and creates a simple programming interface that any developer can use. It's a RESTful API supporting JSON and XML that's self-documenting. It's available now with multiple client-facing devices, including a website,

a twitter account, and a GIF creator. Developed by a team in Cleveland, Ohio and licensed under the GNU general public license.

Sync

Sync concentrates various open source projects stored in different ways into one location, creating an intuitive project directory. Sync downloads the remote repository, compares for changes, and pushes to GitHub. Developed by a team in Guatemala City, Guatemala and licensed under Apache.

Aurora Localization

Aurora Localization via Starfields provides a method for localizing aurora in images taken from the ISS to a location over the earth. The project first uses K-means image segmentation to extract the sky, aurora, and Earth. It follows calculating the lengths of star trails from the brightest stars to get star velocities and extrapolate the angle of the camera using least-squares over expected star velocities. With the angle of the camera and the segmented aurora, we can project the approximate aurora location onto a map. Developed by a team in Toronto, Ontario, Canada and licensed under the GNU general public license.

Best Use of Hardware

The solution that exemplifies the most innovative use of hardware.

ArduHack

ArduHack extends the functionality of the ArduSat to use a camera and send images of the Earth to mobile phones. It uses OpenCV to track the Earth with the camera and adjust the camera angle to center the Earth in the picture frame. The project also used Raspberry Pi & Arduino to greatly improve the future processing power of the ArduSat Satellite. The two communicate by UART/serial, taking care to add a two-thirds voltage divider in between. For the science challenge we mounted a webcam to two servos, driven by the Uno. Using an algorithm, the camera will track an object to keep it in frame & then update the position of the servos to track objects in real time, to be implemented on the satellite. Developed by a team in Exeter, UK, and licensed under the MIT license.

Personal Cosmos

Personal Cosmos is a system that projects data from the earth and from other planets onto a sphere. The system is built with off-the-shelf items by developing an image conversion program. Developed by a team in Tokyo, Japan and licensed under Apache.

Inbound

Inbound displays, in an abstract manner, the frequency with which Earth is bombarded by coronal mass ejections (CMEs). Minimalist and modern, Inbound mounts to any wall to remind people that solar activity has a constant and tangible impact on our planet. Inbound shows colored sections at either end of a board, one red (the Sun) and one blue (Earth). When a CME is

detected by the STEREO or LASCO satellites, we determine its travel time and light the white LEDs on the board to show the CME as it rolls closer to Earth. Developed by a virtual team and licensed under Apache.

ISS Base Station

ISS Base Station is a hardware-software co-design project both expanding the Spot The Station web app and allowing for a physical manifestation of its data. The software side of the project consists of a simple, Santa Tracker-style web app which tracks the position of the ISS in real time over a map of the world, and connects to an augmented-reality iOS app which allows the user to track the station in the sky. The hardware side consists of a physical device which receives data from the app and points at the current location of the space station, and lights up when the station is within a user-defined area. Developed by a team in Philadelphia, Pennsylvania and licensed under Apache.

Arduinos on the Raspberry Pi

Arduinos on the Raspberry Pi solves the Ardusat hardware level 3 challenge by using a Raspberry Pi running ChibiOS (a Real Time Operating System for embedded systems). Inside ChibiOS threads runs Arduino code with help of a library that mimics the Arduino platform. The RTOS can be configured to map pins and devices between the Raspberry Pi and the virtual Arduinos, allowing the maximum use of the sensors in Ardustat. The code and configuration running on the Raspberry pi can be uploaded via serial console for remote management. Developed by a team in Mexico City, Mexico and

licensed under the BSD-2 clause license.

Tiny Sea Bots

Tiny Sea Bots allows an OpenROV to be internet accessible, enabling anyone in the world to view a robot's live underwater video stream and control the robot itself, as well as to control an OpenROV from their desktop with finger accuracy via the LeapMotion controller. Developed by a team in New York City, New York and licensed under MIT.

WebRover1

Webrover1 built a demonstration system which mimicked a tele-operated interplanetary rover complete with a remote control interface, the possibility to add delays, and the ability to construct and deploy autonomous rules onto the robot. A mobile-compatible HTML interface mimics a tele-operated planetary rover complete with remote control, command delays, and the ability to create autonomous rules for the robot. Developed by a team in Exeter, UK and licensed under the LGPL.

Most Inspiring

The solution that captured our hearts and attention.

Karkhana Rover

Karkhana Rovers uses an Arduino clone to construct a simple robot that allows children to explore automation though the uses of sensor feedback and control of rovers over planetary distances. The solution is designed to be a cost-effective open source alternative to commercially available robotic platforms. It also demystifies hardware and electronics by exposing young learners to them in a raw form. Developed by a team in Kath-

mandu, Nepal and licensed under Creative Commons.

T-10

T-10 is a prototype mobile application for use on the International Space Station. Astronauts can program in specific points of interest they wish to photograph, and T-10 will alert them shortly before the Station is set to fly over that location if the current weather permits photography. The app can also alert astronauts to interesting weather phenomenon and potential upload photos directly to Twitter. Developed by a team in London, UK and licensed under MIT.

iSpot It!

iSpot it! focuses on the social aspects of the ISS with the intention of creating awareness, staying connected, and making the ISS fun! The iSpot it! iPhone/iPad app gives you all of the ISS social media links in the palm of your hand, the ability to track your location and share it when the ISS has been spotted, a link to watch the USStream LIVE CAM, and a page to join the mailing list to receive alerts. Developed by a team in Managua, Nicaragua and licensed under MIT.

Launchpad: Moon

LaunchPad: Moon is a fun and educational board game that combines basics of economics and space science in a competitive race to build sustainable industry on the moon. Each turn players have the chance to collect energy, mine for supplies, and make cool stuff. Developed and prototyped by a team in Tallahassee,

Florida and licensed under Creative Commons.

Museum of Intergalactic Species

The Museum of Intergalactic Species (http://discover-voyager.com/) is a fun and easy way to learn about Voyager 1's journey through an interactive online storyline. The goal was to captivate the interests of a broader audience and to entice them to learn more about NASA's missions. Developed by a team in Toronto, Ontario, Canada and licensed under Creative Commons.

Star Hopper

StarHopper created a web application from scratch using Unity to visualize space in 3D and allow users to learn about stars, planets, and asteroids as well as explore the known universe themselves. Using the HYG database the team potted out over one hundred thousand stars with relative distances to each other. They also added planets using the exoplanets database and asteroids using the JPL database. Every star, planet, and asteroid is clickable and can be navigated to. Developed by a team in Gothenburg, Sweden and licensed under LGPL.

Curiosity Rover Blog

Curiosity Rover Blog creates a fictional blog (http://curiosityrover.mpresence.net) where Curie (Curiosity) shares his experiences on the Red Planet. The art is designed to attract young children into the story unfolding outside planet Earth by following the adventures of Curie. Parents and teachers can download the line art

and involve interested children in coloring Curie and submitting their art to the blog. Developed by a team in Atlanta, Georgia and licensed under Creative Commons.

Galactic Impact

The solution that has the most potential to significantly improve life on Earth or in the universe.

Greener Cities

The NASA Greener Cities Project seeks to complement NASA satellite climate data with crowd-sourced micro-climate data, providing higher resolution information for monitoring the environment. The design includes a low-cost garden monitoring sensor, aggregation and normalization of local environmental data, and scaling a global educational initiative for kids to encourage interest in programming and the environment. Developed by a team in Gothenburg, Sweden and licensed under Creative Commons.

People of the Soil

Project Soil is an inexpensive, easy to use system to collect and manage soil data on a global scale. The open system includes a cheap digital soil testing kit to collect data, a light protocol to send the data using web, apps, or even SMS and collect it on a centralised database, an API to disseminate information via SMS or web, and a light web application that can run on old and recent phones for data access. Developed by a team in London, UK and licensed under Eclipse Public License.

Stellar Stuff

Stellar Stuff is an interactive digital tool that takes data from NASA's spinoffs database and turns it into an

educational resource for kids. The tablet application provides an interactive learning experience through gamification, allowing kids to gain a better understanding of NASA's impact on their lives, test their knowledge with a quiz, and earn badges to share on social media sites. Developed by a team in Kansas City, Missouri and licensed under MIT.

Skylog+ NEOws

SkyLog+ NeoWs includes an in-app NEO search/submit/rank system with simplified tools for users, a stargazing journal, a stream of community journal entries, a map with ranked stargazing sites, and more. The app relies on our NEO Web Service (NeoWs), an open-source API for accessing official NEO data. Developed by a team in San Francisco, California and licensed under Apache.

Cloudless Spots

Cloudless Spots detects areas with less cloud by analyzing historical satellite data over the 2001-2012 period via the MODIS Cloud Mask data and by evaluating expected solar power generation. Spots with the best sun exposition in the past can then be used to model return on investment and to guide decisions on where to put the panels. Developed by a team in Tokyo, Japan and licensed under Creative Commons.

Catch a Meteor

Catch a Meteor is an Android application allowing users to visualize a 3D interactive map of the night sky and note their observations of meteors by simply pointing

their device to the direction they saw it, and tapping the screen at the exact location. Developed by a team in Melbourne, Australia and licensed under LGPL.

ChicksBook

ChicksBook is a functional web, Android, and iOS application which can help you learn how to raise chickens and manage the data for your own backyard farm. Developed by a team in Sofia, Bulgaria and licensed under GNU general public license.

World Energy Xplorer

World Energy Xplorer combines decades of solar energy, wind energy and geothermal energy data into one single user friendly map. Developed by a team in Ifrane, Morocco and licensed under Common Development and Distribution License.

Best Concept

The solution that developed the most promising mission concept.

GhOST

GhOST (Greenhouse Open Source Technology) designed and built a model greenhouse system, deployable on Mars and Moon. GhOST is Arduino/Android-based technology featuring RGB LED Lights, wheels, and real-time Android visualisation. The team planted beans on a prototype and sealed it hermetically as a proof of concept. Developed by a team in Sofia, Bulgaria and licensed under GNU General Public License.

DiSCoS

DisCoS (Distributed Control System) is a control net

work framework for any collection of robotic devices. Its innovation lies in the concept of sending missions rather than commands. This is possible because of the .bot programming language the team created. Using DisCoS, they created the TNT education and robotics platform, which allows users to write live code and programs for NXTs. Developed by a team in Abu Dhabi, UAE and licensed under GNU General Public License.

TerraFarming

TerraFarming is a design of a self-sustaining greenhouse on Mars which suggests a specific location on the planet due to the ease of gathering the majority of resources that this requires to function. The team considered all the variables of the planet, such as atmospheric, climatic and geologic, in order to develop the suitable environment for life; while trying to reduce the weight and volume for transport with the use of inflatable structures. Developed by a team in Guadalajara, Mexico and licensed under Creative Commons.

Popeye on Mars

Popeye on Mars is a deployable, reusable spinach greenhouse for Mars. Internally, a fully equipped aeroponic system operates for ~45 days, having all the needed resources, sensors and electronic systems to stabilize the internal environment and help the spinach growth. Also, there are systems for harvesting produced oxygen during the process and the plants at the end of it. Externally, photovoltaic panels provide power, while several cover layers protect the system against Mars extreme conditions. Developed by a team in Athens, Greece and licensed under Creative Commons.

ASTEX

ASTEX focuses on better asteroid orbit prediction via CubeSat. It includes not only orbit prediction and simulation software for the asteroid, but also the CubeSat's technological system developed to received data from the asteroid's surface to study its trajectory and other variables. Developed by a team in Barcelona, Spain and licensed under Creative Commons.

W.AFATE to MARS

W.AFATE to Mars designs a concept to convert recycled computers into 3D printers and other autonomous machines that could be used in exploration. Developed by a team in Paris, France in collaboration with Togo and licensed under Creative Commons.

MS3P

My Space Plant Pod Project (MS3P) is a readily deployable modular greenhouse. Plants are grown in individual pods where conditions are controlled remotely, allowing for experimentation and education. This modular solution allows for low infrastructure, low building structure and high efficiency farming. It was designed to create oxygen, recycle carbon dioxide, and feed astronauts, all while educating students. Developed by a team in Rochester, New York and licensed under Common Development and Distribution License.

A full list of projects can be found at

SPACEAPPSCHALLENGE.ORG/PROJECTS

LIST OF PARTNERS

GLOBAL PARTNERS

US Department of State

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Japanese Aerospace Exploration Agency (JAXA)

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Raspberry Pi

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Sally Ride Science

European Space Agency (ESA)

Met Office UK

University of Dundee Product Design Studio (Scotland)

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JUDGING PARTNERS

Tradeshift

NASTAR Center

A full list of partners, including
local event partners, can be found at

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CREDITS

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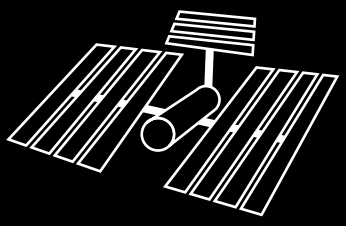

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