OASA Series on Tomorrow's Technologies Today from Space to Earth

I. Introduction

Tomorrow's technologies are being used in outer space and many of them have inspired their commercial use on earth. Have you heard of Tang orange juice which is a brand of powered orange Juice? or the Shanxi Orient, the exercise bike that can be assembled in five minutes in space? Thousands have new products used in space are being used on earth. Conversely, many existing products on earth are being refitted for space.

Designed for Leading Secondary Schools with STEM and STEAM Requirements, this series is OASA's unique offering of extracurricular educational activities for Hong Kong schools. The series looks at certain leading space technologies and their business ventures and analyzed their relevance, use, and application today for Hong Kong, Greater Bay, and Asia. Students undertake short missions as teams and explore the applicability, adaption, and conversion of product specifications of these technologies, for space or use on earth.

Students are pushed to think outside the box but also to remain practical and down to earth. Although some technologies may solve some initial problems, overuse of certain technologies also brings added problems. The overuse of plastic bottles is contributing to having to eat fish that may have microplastic bits in them. Technology is not a cure-all for all problems. Understanding how to work, manage, and apply the right technologies trumps simply knowing how to use.

When US astronauts wanted a writing apparatus that can write upside down in space, NASA spent millions inventing a special space pen. The Russians reportedly used chalk instead. But how did they deal with the challenge of flying chalk? Every solution potentially can create more problems and it is this need to understand our inter-connected and interdependent universe that underpins this series. STEM without humanity's art or application is dangerously biased.

Perhaps the astronauts used a different type of paper or took take away the need to write altogether? True innovation requires a paradigm shift in seeing and thinking; and innovation solves problems. Innovative ideas are better when one understands the power and limitation behind the science, technology, and application that are being introduced to solve the initial problem.

II. OASA's TTT Program

The primary objective of our TTT courses is to expand the exposure and inquisitiveness of STEM for our youth, using the context of space that have excited generations of youth since 1957 when the first satellite was launched by the USSR.

This series helps to develop critical skills in the analyses of the patterns of innovation that are required to leverage the environment, technology, and human resources in business and science in the coming decade here on earth and in space.

We will explore the commercial product specification standards and understand their limitations. In converting usages, trade-offs will need to be made, but are we prepared to make them. Understanding and appreciating tomorrow's technologies and innovation today, on climate change and the cycle of life, helps to prepare the students for new worlds of possibilities as and when they join the workforce within this decade, where by 2030 when there will be several moon bases already on the moon.

Each TTT course covers and drills down to the inner workings, theories, current international product and service specifications, and standards, on one or several of the relevant technologies, specifications, and applications such as:

- Cybersecurity and Space-based data centers
- AI, Big Data, and Cloud (in Space)
- CubeSats
- Ground Stations and Communication Protocols
- Space Solar Power
- Water filtration, Purification, and Recycling.
- Launch Vehicles like Rockets
- Drones
- Traveling to Space and Returning Safely
- Space Food
- Making Things in Space or Additive Manufacturing
- Miniaturization of Satellite or Space Stations
- Agriculture and Hydroponics in Space
- Closed-loop Life Sustaining Systems
- Exercising in Space
- Waste Disposal in Space

III. Background of OASA

OASA is proud to bring the study and application of tomorrow's space technologies to today's youth.

Our TTT program has been designed by leading practitioners – technologists, engineers, designers, astronauts, mission specialists, professors, quality specialists, and businesspersons – and transformed into a hands-on and fun challenge for young problem solvers.

Why OASA?

OASA, or the Orion Astropreneur Space Academy, is a systems leadership development academy for young talents. Founded in 2020, OASA believes that any city, especially Hong Kong, can contribute to the NewSpace Economy that has already arrived. Founders and professionals at OASA have designed new and exciting educational programs from primary schools to post graduate university levels. In many of our programs, OASA would work jointly with professional organizations to develop and refine the course contents and learning process. Market is quite dynamic and by working with professionals who deal with their market, we ensure the program is relevant, timely, and could be shared with their parents acting as coaches.

OASA's courses have these 9 essential elements. They come together to deliver a learning outcome that is uniquely different and inspiring. We believe a key outcome of our program is that students would be inspired to learn further on their own.

A smart city requires smart citizens who understand the practical science behind everyday things on earth.

A. Nine Unique Key Elements of OASA's TTT

1. **Space and Enterprise:** Creating new ventures and value in the NewSpace Economy underpins everything that we do at OASA.

2. **Fun, Exploratory but Practical.** Self-directed learning, properly designed, can be fun. Exploration inherently will include mistakes and wrong turns, but the key is learning from them. Current product specifications in true business settings, and the science and reasons behind them will be explored.

3. **Future Technologies Today.** Not all technologies are useful. Applying the appropriate technologies for the right market is the new mindset. Conventional thinking is challenged and analyzed so that students can learn to think for themselves. Climate change and how to perceive these changes using satellites is one example of what is tomorrow's technologies being applied today.

4. **Globally Connected**. OASA has global mentors that work with students. English is the medium of teaching. Learning is without borders. Inviting speakers from aboard to zoom in and discuss future jobs and preparing for future jobs would be one example.

5. **Hands-on**: Hands-on projects provide a powerful pedagogical reinforcement. Making mistakes and learning not to make them again and seeing the fruits from one's hands-on effort is useful feedback. Our courses blend theory with practice; and students learn how things work. New tools for analyses are introduced as appropriate.

6. **Problem-Orientated**: Project and problem-based that cuts across many disciplines but with STEM as the core. Applying what's learned to future problem solving is the outcome. Students take part in developing evidence-based and data-supported arguments.

7. **Leadership and Teamwork:** Inclusive and team-based, where learning is best done through teamwork and with others, including parents acting as coaches at times. Leadership: individuals are taught skills on how to lead but also working with and strengthening others.

8. **Open Source**: As much as possible, OASA will encourage the use of open-source materials and teaches students to explore the world of exploration on their own. Sharing is key to humanity's sustainability.

9. **Quality Focused**. Only the best quality for your children. Everything we do must continually get better.

IV. Preferred Workshop Structure

Typical Workshop Parameters

1. Each workshop is no more than **2.5 to 3 hours** long and includes both theories and practices.
2. Flipcharts, zoom, overhead projects are supporting tools.
3. Small classes and Team Learning. 20 to 25 students per workshop. 4 to 5 students per team. 2 to 3 training helpers.
4. Exercises predominantly where students would be challenged and where mistakes will be made.
5. Teaching is done in English (with Chinese added verbally to enhance learning) or in Chinese (with English added verbally to enhance learning).
6. Typically, one facilitator with one helper in each workshop.
7. The classroom setting should have moveable chairs for individual and teamwork. Teamwork is often preferred.
8. For some of the programs, students are first taught to break apart an application then are given ample opportunities to reconstruct parts or all the applications.
9. Students would dissect the reasons and methods on how certain product and technical standards are used and the limitation of such standards. HACCP and GMP for food for example.

V. Special Sessions Uniquely at OASA

These unique OASA sessions can be added to enhance learning and retention for each of our courses. These sessions range from 30 minutes to 45 minutes each and they are highly modular. One or several of these can be added to enhance learning and application of the learning.

A. Interviews with Global Experts via Zoom
B. 360 Systems Leadership Competency Assessment on Space Preparedness Exercise
C. Introduction to Some Innovation Tools
D. Project Management Skills Enhancement (AGILE)
E. Risks Management Skills Enhancement (COSO based)
F. Global Mentoring Corner
G. UN's 17 SDG Goals

A. Interviews with Global Experts via Zoom

A 30-minute zoom discussion where an expert relevant to the topic at hand would be interviewed by the facilitator over zoom. These professionals would include professionals, professors, and businesspersons from around the world. Questions may include:

1. *Why do you think your space technology is appropriate today?*
2. *Who are you and what do you teach or what are you an expert at?*
3. *Why do you think that the Space Economy is here and what impacts do you see for young people as they learn to lead in this ecosystem?*
4. *What are the limitations of the current product specifications used?*
5. *How did you choose your profession? How should young people prepare for such a profession?*
6. *What defines you at work or outside of work?*
7. *What had inspired you to do what you do today?*
8. *Has there been a teacher or mentor who has made a meaningful contribution in your life?*
9. *What advice would you give someone in S1 (depending on grade)?*
10. *How does one get to be invited to attend your university?*

B. 360 Systems Leadership Competency Assessment on Space Preparedness Exercise

Understanding the strengths and weaknesses as perceived by oneself, by peers, and by one's family, would be beneficial in aligning the development path for the young leaders. Using Sir David's Timeless Leadership set, which is a system leadership competency set, young pioneers would select the relevant competencies and identify their path of development towards becoming a systems leader.

C. Introduction to Innovation Tools

Knowing which innovation tool to apply and how to apply relevant innovation tools is a skill that must hone and refined. Tools that can foster innovation – such as Nine-Windows, Rapid Prototyping, Six Thinking Hats, and even Brainstorming – would be taught and practiced.

D. Project Management Skills Enhancement

All team projects require effective project planning and management. Simple Gantt charts, critical path, and risk management must be understood before any plan can be designed and used as a communication instrument and project management can be used from planning a party to planning a Space mission. The AGILE methodology will be taught here.

E. Risk Management Skills Enhancement

All actions involve some level of risk. Businesses are designed to confront and mitigate risks. As they say, boats are safe inside a harbor, but that's not what boats have been designed for. To be able to anticipate what these risks are, set up plans to mitigate them, and employ tools to transfer such risks are what separates the cowboys from true risk-takers. Spaceships are safe at spaceports, but that's not why we have spaceships.

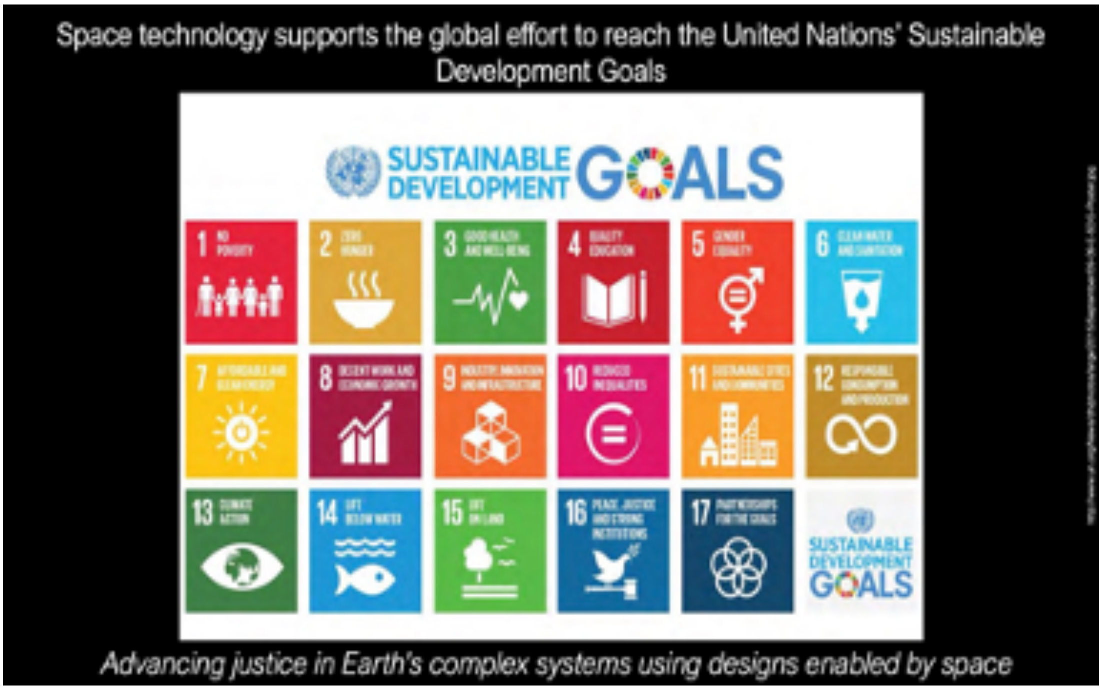
F. Global Mentoring Corner

OASA has a growing database of retired professionals and scientists who have studied and work abroad and are eager to learn and work with young people. Together they form our global mentor team. Depending on needs, these professionals can work with an individual or a team for over a few hours. These mentors would be trained by OASA's Master Trainers on how to get the most out of the mentoring relationship. They have also agreed to our stern policy on restricting discussions on scientific, business, and engineering.

G. UN’s 17 SDG Goals

Our earth is our spaceship. To live and prosper here on earth means having a good understanding of climate change and the technologies being used to support the efforts of sustainability. Technologies designed for Space can have a significant contribution to the earth. Space technologies such as satellite earth observation, satellite positioning and navigation, human flight and microgravity research, satellite communication, and space technology transfer can improve human's effort for sustainable development.

OASA is currently working with a number of international Space institutions, to petition the UN, to create SDG 18 which is “Space.”


Space technology supports the global effort to reach the United Nations' Sustainable Development Goals
SUSTAINABLE DEVELOPMENT GOALS
Advancing justice in Earth's complex systems using designs enabled by space

VI. Possible Project-Based Missions

Space-relevant projects with clear mission parameters are the best way to learn.

Each of the topics can be covered in one or several half-day workshops, depending on the topics chosen and the depth to be covered for the grade. STEM topics are covered via an interdisciplinary basis, as in the real world. Each course uses real-world examples and students are exposed to the history of science and applications, but their designs and ideas are not bounded by past realities.

Sample missions:

1. Design a new poster or video to recruit Astronauts.
2. Make real soil with your food waste.
3. Devise a plan or showcase with a video on how to make dinner in zero gravity space.
4. Devise a new way to land a Rover on Mars.
5. Plan what to take for a three-month journey to a new space station.
6. Design the blueprint for a Space Hotel on the moon (or on earth).
7. Set the design requirement for a Space Suit.
8. Design the interior of a spacecraft that can house 5 persons for 6 months.
9. Calculate the ellipse of orbits for low earth orbiting CubeSat.
10. Conduct a risk assessment exercise for a journey to the moon (or to Mars).
11. Apply to have the ISS or Tiankong speak to the class (in cooperation with the HAM Radio Society)
12. Design a 3-D printed house on Mars using locally available materials.
13. Design an elevator to space.

14. Propose a way to sell Hong Kong Designed products and have those products 3-D printed and delivered at a foreign location.
15. Create a new space business and use the Business Canvas to explain the Business Model of the business.
16. Create an infographic on an application/technology that is being used in Space.
17. Design and create a moonshot program for the parent's company.
18. Propose and plan out a Special Action Group project for OASA.
19. Propose and design a new job in the NewSpace economy.
20. Prepare to be the next Space Pioneer.
21. Using Space or Geo-locational data to identify new markets on earth.

Please speak with one of our Programme Directors or President on which of the subject(s) would appeal to your students.

Sample Mission Outlines

Astronauts and mission specialists have missions. Space is hard and technologies must work. Each mission cannot end up in error and a tremendous amount of planning, replanning, testing, rapid prototyping is done. Key risks are identified with alternatives and work-around installed as mitigation measures. Learning and recognizing one's limitations, working with others to minimize any gaps, and being innovative in one's solution was the key learning of the Apollo 13 mission. As in life in space, errors and misjudgments must be corrected, else people's lives will be at risk.

Following are examples of mini-missions that spacefarers may have to encounter.

Mission 2: Create real soil using your food waste

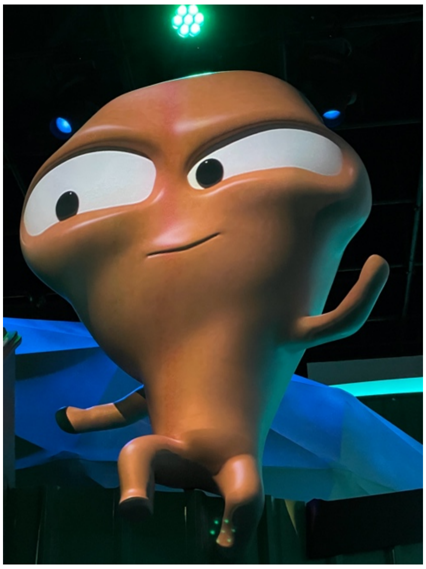
Level: Grade School 5 and 6
Number of Students: Max 25.
Duration: Two workshops. One is a visit to O Park. 2.5 to 3 hours each.

Learning Objectives:

- Learn to create, plan, and organize the reality of the conversion of food waste into reusable energy.
- Understand the chemistry and relevant certification standards.
- Understand the risks, implications, and consequences of bad and careless planning with simple chores.

Major Activities:

1. Map the food decomposition process on paper and understand the anaerobic digestion and composting technologies used to recycle food waste into biogas and compost.
2. Visit the Hong Kong Government's O-Park (this will take 3 hours) and understand the complete food decomposition process and how food waste is turned into energy.
3. Using a flowchart, map out the sequence of activities needed in turning food waste into energy inside a spacecraft (limited space, energy, and equipment).
4. Prepare food waste for decomposing.
5. Use compost as fertilizer for plants.



Mission 3: Devise a plan or showcase with a video on how to make dinner in zero gravity space.

Level: Grade School 5 and 6
Number of Students: Max 25.
Duration: Two workshops. 2.5 to 3 hours each. Possible to add a Mentoring and Feedback Session by Global Mentors as an added workshop.

Learning Objectives:

- Learn to create, plan, and organize the reality of cooking a dish of a hot meal on earth and in space.
- Discover the range of past, current, and new technologies available for cooking, eating, and dining in a zero-gravity environment.
- Understand the risks, implications, and consequences of bad and careless planning with simple chores.

Major Activities:

1. Watch the history of cooking and the choice of food available for seafarers and astronauts.
2. Brainstorm various ways to cook and consume cooked food in space.
3. Using a flowchart, map out the sequence of activities needed in preparing, cooking, eating, dining, and disposing of food in Space.
4. Prepare a diet plan that gives astronauts the proper daily nutrition and caloric intake.
5. Prepare a recipe for a favorite dish and propose the needed adjustment in preparation for such dish to be cooked in space.

Mission 11: Apply to have the ISS or Tiankong speak to the class (in cooperation with the HAM Radio Society)

Level: Grade School 5 and 6
Number of Students: Max 25.
Duration: Two workshops. 2.5 to 3 hours each. The best time for the second session occurs when the space station is within range.

Learning Objectives:

- Learn to plan and organize the protocol of international communication.
- Understand the logic and use of long-distance communication equipment and apparatus.
- Understand the risks and consequences of miscommunication.

Major Activities:

1. Learn to track the location of satellites and space stations.
2. Work with HAM Radio experts to fill out an application for dialogue with real astronauts working in space.
3. Study the rules and procedures in using long-distance communication equipment at a HAM Radio Station.

Mission 16: Create an infographic on an application/technology that is being used in Space.

Level: Grade School 5 and 6
Number of Students: Max 25.
Duration: Two workshops. 2.5 to 3 hours each.

Learning Objectives:

- Learn a range of space technologies and decide on which one to drill deeper by a group of students
- Understand the technological limitations and constraints being put on human activities for outer space missions
- Simplify complex technologies into easy to share and understand concepts for other students
- Demonstrate the key elements of storytelling using infographics

Major Activities:

1. Pick one or two space technologies that interest the group.
2. Conduct open research to understand, document, and reference such technologies, citing new terms and concepts for sharing.
3. Identify limitations and constraints of the technologies in space and the adaptation needed to work on earth.
4. Work with infographic creation software and play with design, colors, hue, and placement.
5. Compete with other teams on the visual, content, and clarity of the infographics.

Mission 17: Design and create a Moonshot Program for Parent's Company

Level: Secondary School, S3 - S6
Number of Students: Max 25.
Duration: Three workshops. 2.5 to 3 hours each.

Learning Objectives:

- Learn to plan and organize a new space mission
- Reach out, engage, and understand parent's businesses and their potential for survival and Moonshot in the NewSpace economy
- Develop critical thinking and learn to apply risk management on top risks
- Understand and apply systems thinking in designing new ventures

Major Activities:

1. Incorporate project and risk management tools in designing and putting together a Moonshot Program (a big, audacious, and far-sighted project that can extend the life of the company).
2. Understand and analyze parent's business and viability in the NewSpace Economy using a checklist on innovation readiness, technological readiness, and commercial readiness.
3. Interview one parent and write up the work of their employer using the SODAR tool, then devise a Moonshot Program based on that.
4. Put together a 10-page PowerPoint to propose a Moonshot program for the parent's company.
5. Present the learning to peers using storytelling.