

## IAA Study Group Status Report

Responsible Commission: Multi-Commissions: 1, 2, 3 and 6

Study Number and Title: 6.16 Multi-Commission  
STEM/STEAM for Space - Grand Challenges

**Short Study Description** (from Study Group Proposal): The launch of Sputnik in 1957 marked the beginning of a global surge in interest in science, technology, engineering and mathematics (STEM) education. The world was excited by each development in space exploration. Not only were there vast improvements in STEM education, but also an increase in participation in these disciplines by our youth. Many of them eventually joined this exciting endeavor, while others utilized their education to benefit mankind in a myriad of other ways. In the 60+ years of the space age, developments have continued apace in the physical sciences. Recent years have also seen impressive advances in the life sciences stemming from space research. These advances are steadily moving toward the enablement of humanity to go beyond near-earth orbit on into the cosmos.

**Our objective:** As space research has stimulated STEM education, improvements in technical education have benefitted space research and, indeed, all aspects of society. Less recognized is the interaction between the creative arts, space research and STEM education. Space research has stimulated the imagination of the art community in music, architecture, literature, and the graphic arts. Technical developments have made possible new methods of creating works of art. And conversely, the arts have stimulated creativity in science, technology, engineering, mathematics – and space research. It is this complex interaction we have dubbed STEAM. We propose to study this interaction with the objective of increasing the benefits to all. The first step will be to gain a clearer picture of where we are today on the interaction between STEAM education and space research. Then we will address questions such as the following: How can we improve STEAM education for the benefit of space research and vice versa? How can we develop a coordinated initiative to support development of high-quality STEAM education? Should we encourage the sort of competitions that have proved so successful in other fields, such as robotics, in our universities, high schools and, yes, even with younger students? If so, how can we persuade governmental space agencies, foundations and private industry to help? While learning from the past, we need to look to the future to fully benefit from the complex interaction between space research and education in science, technology, engineering, art, and mathematics. We need a bright, enthusiastic generation for future space activities and they need us now.

### Progress in the past:

The members of the Study Group met at IAA Headquarters during the Academy Spring Annual meeting in Paris (March 2017). Members discussed the importance not only of STEAM Education but also Space Engineering. Space applications in science, technology and business will experience a substantial increase in the next 10 years. It is essential to have a workforce with a strong background in space-related subjects. As an example, Study Group member Dr. Jordi Gutierrez (Spain) presented plans for a Space Engineering degree at the First Symposium on “STEM/STEAM for Space” last year in Paris. It was well received. Many members from different countries expressed strong interest and support of this development and recommended that this topic constitute one of the special sessions for the Second Symposium “STEM/STEAM for Space. Grand Challenges”.

The space industry has an aging workforce. Young engineers are needed not only to replace those that are retiring, but also to bring a new set of **advanced, multidisciplinary skills and support new businesses**. Thus, the employability of engineers and scientists well educated in STEAM for Space and in Space Engineering is certain. We are sure that graduates in many countries involved in space

endeavors will be highly successful. This new generation of space scientists and engineers will apply their knowledge, energy and passion to benefit local, national and international space research, industries and economies.

They will be the leaders of tomorrow!

**The members of the Study Group met at the IAA Headquarters (November 2018)** to discuss preparations for the Second Symposium on STEM/STEAM for Space - Grand Challenges. Following is the status as of September 20, 2019.

**Second Symposium on “STEAM for Space Leaders of Tomorrow”  
MIT, Cambridge, USA, October 28-29, 2019, immediately after WSC in Washington DC.**

**Co-Chairs: Prof. Dr. Liya Regel (IAA); Prof. Dr. Wesley Harris (NAE, IAA)**

**Speakers:** Members of National Academies, government agencies, universities and companies

Program/Organizing committee was formed for the Symposium on “**STEAM for Space Leaders of Tomorrow**,” the first announcement and call for papers posted by IAA, speakers were solicited, and those selected for presentation were selected (shown below).

#### **Issues requiring resolution?**

Completion of the organization of the Second Symposium.

#### **Product Deliveries on Schedule:**

On March 25, 2016 the first Symposium was held in Paris with impressive lectures and lively discussions by the international participants on developments in STEM/ STEAM relevant to space activities.

**“Paris seemed to be the most appropriate venue for the first symposium on STEAM for Space because it’s most notable landmark and cultural icon is the Eiffel Tower, a perfect illustration of the union of the STEAM subjects,” said Professor Regel, chair of the SG. “In 1889, Gustav Eiffel completed his magnificent beautiful creation using his knowledge of science, technology, engineering, art, and mathematics. And where does the tower point? To space! It reminds me of a rocket on its launch pad.”**

The program was created by selecting abstracts submitted by representatives of institutions around the globe. Several new members joined the Study group, as the study moved to the next stage after this first highly successful symposium.

The First Symposium on STEM/STEAM for Space was successfully held with the outstanding help of the IAA office in Paris.

**The Second Symposium on “STEAM for Space Leaders of Tomorrow” is scheduled for MIT on October 28-29, 2019. Lectures will be on Monday 28 October and a tour of laboratories the next day, Tuesday 29 October.**

**Name of person providing Study Group Status:**

Prof. Dr. Liya Regel (Chair)

**Status Report Date:**

September 20, 2019

**Chair:** Regel, Liya

**Co-Chair:** Harris, Wesley L.

**Secretary:** Maizza, Giovanni

The academy invited Prof. Dr. Regel to chair the study group with MIT Professor Dr. Wesley Harris, a member of the prestigious U.S. National Academy of Engineering. Members of this study group included well-known scientists and educators from space agencies, government research organizations, universities, and aerospace companies from many countries.

**Activity:**

Study group Proposal Form

Status report, September 2014

Status report, March 2015

Status report, August 2016

Status report, March 2017

Status report, September 2017

Status report, March 2018

Status report, September 2018

Status report, February 2019

Status report, September 2019

Study group meeting, 25 March 2015, Paris, France. Agenda of the meeting

1st IAA Symposium on STEM/STEAM for Space, with theme:

**“Emerging STEM / STEAM and Space”** Paris, France, March 25, 2016

2<sup>nd</sup> IAA Symposium on STEM/STEAM for Space, with theme:

**“STEAM for Space Leaders of Tomorrow”** scheduled for October 28-29, 2019, Cambridge, USA. Scheduled speakers are shown below.

**Introduction:**

**STEAM for Space Leaders of Tomorrow**

**Liya Regel**

Clarkson University, NY

USA

**Keynote Address:**

**On the Application of STEAM Principles in Space Project Design**

**Wesley Harris**

Massachusetts Institute of Technology, Cambridge, MA

USA

## Accepted papers below in alphabetical order by first author:

### Human-Systems Integration as a Technique and an Art for STEAM in Space.

**Guy Andre Boy**

*Saclay University, Paris  
France*

### The International Space University (ISU): Reflections on 32 years of Developing Future Leaders for the Global Space Community

**Steven Brody**

*International Space University  
USA*

### Femtosatellites for Space Education

**Jorge Luis Gutierrez Cabello**

*Universitat Politècnica de Catalunya  
Spain*

### Contributions of the National Space Research and Development Agency (NASRDA) to the Development of Science, Technology, Engineering, Arts, Mathematics (STEAM) Education for Space in Nigeria

**Peter C. Ekweozoh mni, Anietie S. Ekanem**

*Federal Ministry of Science and Technology, Abuja  
Nigeria*

### STEM and Space Education for Girls

**Tamara Hudgins, Ph.D.**

*Girlstart, 1400 West Anderson Lane, Austin Texas  
USA*

### Equipping today's STEM workforce for the New Space Era

**Jeanette Jones**

*Alabama A&M University, Huntsville*

**Lakiesha Hawkins**

*NASA Marshall Space Flight Center (MSFC), Alabama 35812  
USA*

### Breaking the STEM stereotype towards developing the next generation of leaders

**Amal Khatri**

*South African National Space Agency (SANSA)  
South Africa*

### Astronaut Poets and the Need for Holistic Thinking in Space

**Michael Lee**

*Duke University, Durham NC  
USA*

**Space Exploration and the Arts: A call for Trans-Disciplinary Collaboration to Redesign Science Itself**

**Roger F. Malina**

*University of Texas at Dallas  
USA*

**Machine-Machine to Major Tom: Cyberethic**

**John McClellan Marshall**

*Fourteenth Judicial District of Texas  
Dallas, TX  
USA*

**Education, Humans, and Autonomous Space Doctors: Using Medical Robotics for Space in STEAM Education to Encourage Interest and Incite Creativity in Future Engineers**

**Siobhan Rigby Oca, Daniel Buckland**

*Duke University, Durham, NC  
USA*

**Innovations in STEAM Education for Space in Africa**

**Temidayo Oniosun, Joseph Ibeh, Jerry Chiemekwe**

*Space in Africa, Lagos,  
Nigeria*

**Storytelling in STEAMSpace: Integrating Arts and Space Science**

**Jyoti Ranjan**

*STEAMSpace Consultancy Services D-3/01, Mumbai-400093  
INDIA*

**STEM/STEAM Education from an emerging economy perspective: the case of Paraguay**

**Alejandro J. Román M.**

*Paraguayan Space Agency  
Paraguay*

**Current Implementation of STEM/STEAM in JAPAN: STEM and JAXA's Effort**

**Kaori Sasaki, Nozomu Sakuraba**

*Space Education Center, JAXA  
Japan*

**From a Chessboard to the Moon Village at Full STEAM**

**Oleg Ventskovsky**

*Yuzhnoye Design Office European Representation in Brussels  
Belgium*

**Creative Performance in the Extreme Human Environment of Space**

**Herie de Vries**

*Yale University, New Haven, CT  
USA*

## **Study Group Membership:**

Alifanov Oleg M  
Boy Guy Andre  
Cai Guobiao  
Duarte Carlos  
Deng Yulin  
Ercoli Finzi Amalia  
Frischauf Norbert  
Ghafoor Nadeem  
Gany Alon  
Gutierrez Jordi  
Liu Qiusheng  
Kozlovskaya Inessa B  
Malina Roger F  
McPhee Jancy C.  
Munsami Valanathan  
Lavagna, Michèle  
Oliver Carol  
Orlov Oleg  
Ortiz Gil Amelia  
Ramachandran Radhika  
Reibaldi Giuseppe G  
Roman M. Alejandro J.  
Sasaki Kaori  
Vavilova Irina B.  
Ventskovsky Oleg  
Zhuang Fengyuan