ESPACE DANS MA VILLE: WHEN THE HEART OF SUBURBS BEATS TO THE RHYTHM OF SPACE DISCOVERIES

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ABSTRACT

Espace dans Ma Ville -Space in my City- is a programme initiated in 2005 that is proposed to French municipalities. Within each city visited, and over one week, CNES and Planète Sciences offer and perform a full set of space-related activities to youngsters from underprivileged areas during school holidays. Throughout activities and project, youngsters discover about sciences, technologies and space; they discover how much teamwork is important, they understand the key-role of each individual within the team to complete a common project and they also discover about the benefits of the experimental process. The projects are promoted within the neighbourhood and also at a national level. This successful programme involved 21 cities and 12'000 participants in 2008. In order to pursue its development, *Space in my City* will extend its reach to rural areas and cities in Europe.

Keywords: Education, Social, Space benefits, Activities

1-Background

1.1 CNES, the French space agency established in 1961, is a public organization [1]. It conceives and executes space programmes with its partners in the scientific community and industry, and is closely involved in many international cooperation programmes—the key to any far-reaching space policy. Its mission is to guarantee access to space capability and its use for all national and European needs. This includes support to space amateurs and the transmission of sciences and techniques awareness to the population. Under the control of CNES, Planète Sciences, a non-profit organisation, was formed in 1962, initially to provide assistance to space clubs for the design, manufacturing and launching of the experimental space projects rockets.

1.2 Planète Sciences is a network of regional associations who promote sciences and technology through practical activities and experimentation to youth from elementary school to university levels [2]. The spectrum of thematics has broadened over the years and now includes, space activities, astronomy, robotics, environment, meteorology, energy and archaeology.

Further to nation wide programs and trainings, Planète Sciences organises events or contests such as Eurobot and Eurobot Junior, First Lego League, *La nuit des étoiles* (the night of the stars), the national launching campaign [3].

2-Espace dans ma ville: *Space in my City*

2.1 Origin and objectives

The programme called *Space in my City* [4] has been initiated in 2005 by CNES that was willing to reach youth from underprivileged areas. A pilot has been carried out during the summer months of 2005 within 5 French cities. Having met a wide success, the operation has existed since then; since 2007,

about 20 cities in France host *Space in my City* during spring, summer and autumn schools holidays (from April to October).

Space's appeal is strong, it motivates to go beyond, to share, and as such, the space topic reveals to be a powerful tool to entertain, trigger imagination and teach kids.
Space in my City is aimed at youngsters who live in underprivileged areas of large cities, who are usually not exposed to science and technology. The objectives of the initiative are:

- To contribute to help the youngsters from deprived areas to find their place in Society.
- To boost their city and neighbourhood's image
- To encourage long-term local initiatives for scientific activities, with a focus on Space topic
- Making science something they can enjoy

Space in my City is a week-long programme of events and workshops dedicated to science and space in underprivileged areas of cities. Lone youngsters or youngster groups from social centers are welcomed by leaders under light open tents installed in their area. An indoor wide space, "the Space media center" also welcomes youngsters who want to learn on their own, discover an exhibition, watch DVD or CD-ROM…
All of these resources are prepared, updated and translated into English by the volunteers of Planète Sciences.

2.2 Actors, partners and coordination
The operation has been supported from the beginning by the Ministry in charge of Urban Affairs, under the interministerial *Ville-Vie-Vacances* initiative – a key component of the French government new urban social cohesion. It is set up by ACSE (Agence Nationale pour la Cohésion Sociale et l'Egalité des chances), the National agency for social cohesion.

Space in my City is supported as well by:
- CNES, the French Space Agency
- Ministry for Higher Education and Research
- Ministry for Health, Youth and Sports
- Each hosting city

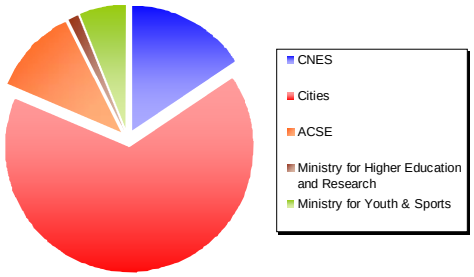

Fig. 3 Origin and distribution of the funding

Planète Science is in charge of the setting up the programme, nation-wide and locally, in close relationship with CNES. The operational implementation with the municipalities is managed by the regional branches of Planète Sciences

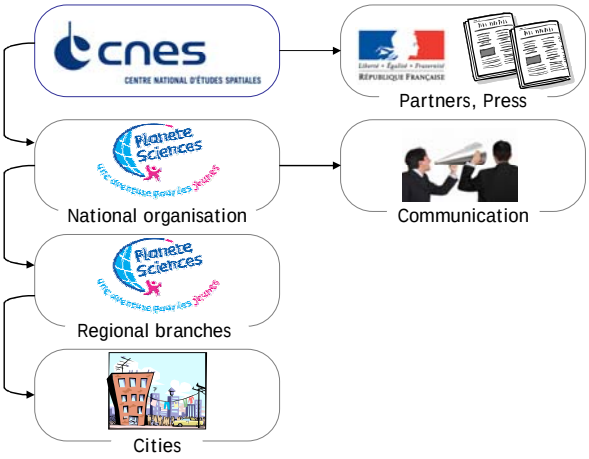

Fig. 2 Organization of *Space in my City*

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2.3 National coordination: a 13 months schedule. The general organization of the operation kick-off takes place in September with events scheduled from April to October the next year.
October-November: in partnership with CNES, Planète Sciences sends a registration file to municipalities that are member of the Urban Social Cohesion programme. CNES and Planète Sciences select the candidates based on common criterions.

January/February: once selected, cities are invited to meet with Planète Sciences for a first project coordination in March. About 3 to 4 meetings are planned with the municipality on top of regular phone contacts.
September/October: Planète Sciences publishes the reports: one per city, and a global report.

Training the leaders, the field-actors of the operation
Planète Sciences recruits and trains the teams of leaders in science communication: the key elements of *Space in my City*. The training programme includes space activities, techniques for material usage, pedagogy and experimental process.
Leaders are also receive training dedicated to *Space in my City* : team management, group management, dealing with the press, dealing with partners (municipality, officials, CNES) and material management.

Training local actors: thinking forward for the long term
One of the main objectives of *Space in my City* is to establish long-term scientific activities and techniques on selected areas. To meet this objective, Planète Sciences is delivering trainings to local leaders, in their city. Depending on their objectives and projects, the training range from with simple discovery of the activities to scientific project establishment for kids. Hence, the local leaders are able to organize workshops to prepare youngsters to the forthcoming *Space in my City*, to develop robotics or rockets challenge or complex projects throughout the year.

Material and equipment
Planète Sciences is responsible for the preparation and delivery of all the material and equipments required to set-up *Space in my City* on the field. During the summer holidays, three distinct circuits are run in parallel: it consequently requires 3 sets of identical material, tools, equipment. Planète Sciences staff members and volunteers are dedicating a large part of their time to the preparation of all these equipment sets. The sets are renewed and enhanced every year based on leaders' feedbacks.
Material and equipment are adapted to the travel constraints of *Space in my City*. They are transported from a city to another in utility trucks: unloaded on Monday morning and reloaded on Sunday afternoon. Planète Sciences recruits the drivers and is in charge of organizing the transports logistics.

A programme full of activities
Year after year, the set of activities offered by Planète Sciences is denser and innovating. About fifteen different activities are proposed; in 2008 5 new activities have been included in the content of *Space in my City*.
Activities are entirely designed by Planète Sciences. With the support of scientists (astronauts, researchers at CNES, engineers) and volunteers involved in pedagogy and experimental process knowledge transfer. Pedagogy books are prepared for the leaders to help them better prepare their activities and workshops.

Documenting: to maintain quality and sustainability of the programme
From the very beginning, Planète Sciences has been documenting the programme's preparation: manual for the regional coordinator, for the national coordinator, manual for the science communicator, as well as a quality plan for the complete operation.

2.4 Site constraints and municipalities contribution to the equipment
Each time *Space in my City* stops, it offers a week-long programme of events and workshops dedicated to science, within an area identified by the municipality.

Besides the four large open tents under which the activities take place, the host municipality offers a wide indoor space to set-up the "Space media centre" and an inflatable planetarium. The Media centre everyday welcomes all the youngsters who

want to know more about space; this place is also host for a couple of workshops such as "Build your Satellite" or "Build your Solar System". The library is the place where youngsters can wait for the beginning of their next activity.
Rockets launching and Giant Fresco require a 5000m2 open field –a football field for example- close to the activities site. All the sites proposed by the cities are validated beforehand by Planète Sciences.

Fig.3 Young scientists at work in their area


Oualid Ben Salem - Pixprostudio
Fig.4 Reaching space from home

3-Youth and Space

3.1 *Space in my City*: the content offered

The activities are offered to youngsters from underprivileged areas of the cities. Youth social centres for leisure and culture are all invited to participate.

There are about fifteen activities proposed by Planète Sciences [5], within 3 main categories:

Project activities:
Project activities extend over several days in order to let the youngsters encompassing the experimental process. They can be prepared ahead of the operation within the local youth centres.

- Water Rocket
- Micro Rocket

Youngsters build their own rocket. They learn about the action/reaction principle, they discover in details the parts that compose a rocket, they study different parameters involved in the rocket's flight.

- Build a mars rover

The challenge of the activity consists in building a robot capable of moving and avoiding obstacles. The youngsters discover the basic principles of electricity and learn different mechanical designs for motion transformation, as well as piloting a robot.

- Build a weather balloon scientific payload

The weather balloon raises above 30km above the ground, while planes barely fly above 10km: a weather balloon is the ideal vehicle to answer questions such as: "what happens so high in the sky?", "is it more hot or more cold over there?", "can bird breath and fly so high?". The youngsters raise assumptions and set up experiments to obtain answers. Experiments are placed onboard a basket hanging from the weather balloon. It is released during the week.

Discovery activities
Because not all the youngsters from the neighbourhood are joining the local social centres, Planète Sciences is proposing short activities, from 1 to 2 hours, to introduce individuals to Sciences and Space.

- Build your satellite

This workshop is addressing the satellite questions: what is it, what is it used for, where is it…how it works? Young engineers are wearing clean-room gears in order to assemble their satellites from building

blocks: bus, antenna, solar panels, and experiments modules…just like real engineers. Each of the blocks is reviewed to understand its function. Further to the construction, the participants simulate a satellite link: they must transmit emergency messages or information from a transmitter to a receiver.

- Space and meteorology

Observation satellites take pictures of the Earth, the clouds… this workshop brings the youngsters to understand what the images say like a weather forecast presenter. Hey! and why not joining the local radio station to present next weather bulletin?

- A giant fresco visible from space

From 3x3 meters pieces of cloth, the participants "draw" a fresco on the ground; this fresco will be visible from space as the resolution of on pixel of the SPOT satellites family is 9m2 on the ground. Once the fresco is laid on the ground, it is captured from a digital camera hanging below a helium-filled observation balloon.

Fig.5 A giant fresco smile at the satellites

- Satellites to save the Earth

Observation satellites such as SPOT help to study our environment: what is the flooding risk-level for a city? How fast is forest shrinking in Amazonia? Thanks to satellite images and maps prepared from those, youngsters are brought to answer these questions and thus better understand the purpose and role of space-based observation of the Earth.

- Train like an astronaut in the pool

To get prepared to zero gravity conditions, astronauts rehearse their future mission under water. Alike astronauts, youngsters simulate Extra Vehicular Assembly (EVA), as for example on the International Space Station (ISS).

- GPS Rally

Participants are provided with a GPS receiver to locate hints distributed in the neighbourhood. All along this mission, the youngsters understand about the principle of satellite localization, about latitude and longitude notions, and how the GPS system works.

- Discover the stars

Under the inflatable planetarium, sky watchers learn about stars and constellations.

- Astronomy

A large set of activities bring the young astronomers to build a sundial, a sky chart, a telescope…they discover astronomy through entertainment.

- Build your solar system

Let's travel through the solar system together with space probes (Cassini-Huygens, Rosetta, Smart1, Mars Express …) that explore the near-Earth universe. Participants discover the specificities of the planets, they build at-scale models of the planets and they learn about sizes and distances.

Permanent activities

All the week long, the "space media centre" is opened within the structure that hosts *Space in my City*. This media centre contains, space related books, comics, magazines, CD-ROM, multimedia activities DVDs, movies and documents. It is an important resource of information for the leaders but it invites the youngsters to learn, in autonomy, to learn more about space, with fun.

Space in my City aims at developing a true dynamism within the neighbourhood. Beyond the content proposed by Planète Sciences, local organizations are invited to participate in various ways:

- To bring in leader to assist the team of leaders from Planète Sciences.
- To propose related activities or demonstrations (at scale models, student projects, real parts of rockets, satellites, cosplay…)
- To organize collateral events: outdoor movie, conference, snack and learn...
- To organize visits of science and culture sites

Fig.6 Cosplay is one of the space-related activities proposed by local associations

3.2 Zoom on activities:

Space training in swimming pool (Underwater simulation of EVA)

Astronauts' training includes Extra Vehicular Activity (EVA, or spacewalk) in swimming pools because underwater conditions simulate the best zero-gravity conditions. Part of the programme *Space in my City*, the Space training in swimming pool is based on the actual trainings of astronauts. The young astronauts are placed in similar situation during the activity, the purpose of which is to reproduce a repair or maintenance mission on the International Space Station (ISS).

The objectives of the activity are:

- Understand the notions of absence of gravity, Archimedes, pressure
- Discover about the space modules: ISS and Columbus (European Module of ISS)
- Learn about the tasks of the astronauts: training in swimming pool to prepare for EVA
- Bring youngsters to learn about the experimental process
- Observe and process data and experiment results
- Learn to work within a team

The activity takes place at a municipal swimming pool and consists in 3 sequences:

Sequence#1: out of the water, participants are brought to think forward about their mission(s) and to learn about the necessary scientific notions or skills they'll have to deal with.

The notions are presented throughout experiments. On top of these, underwater communication principles are presented.

Several missions are proposed; they can only be achieved by pair in order to develop collaboration skills and to better match real conditions.

Sequence#2: missions take place underwater, around equipments modelling the ISS and its European module "Columbus". The different missions proposed are realistic:

- Solar panel repair
- Electrical connection of Columbus module to the ISS
- Installation of a camera to watch over the outdoor payloads.

To simulate even further real space conditions, whenever an object is dropped by an astronaut, it is considered lost in space.

For older participants, an extra mission consists rescuing an astronaut who is not tethered anymore to the station and is dangerously free floating in space.

Fig.7 Young astronaut training underwater on ISS maintenance

Sequence#3: out of the water again for a debriefing of the mission. The young astronauts give their feedback and relate their experience, the conduct of the mission; they analyze the results, successes, failures and difficulties encountered.

The pool: an unusual place to organise a scientific activity:
The swimming pool is an appealing place for the youngsters, especially during the warm summer season. *Space in my City* leverages this appeal as much as possible to bring youngsters to discover about exciting and funny science activities.

From zero-gravity down to daily life on Earth:
During the first sequence, the participants think forward about zero gravity effects and underwater communication modes. They quickly understand how much communication plays a critical role in the success of the collaborative mission. During the third sequence, they are given the opportunity to give feedbacks, to comment, analyze and propose ideas for improvements.
Original equipment:
The equipment involved in the activity has been created on purpose. The models have been imagined by Planète Sciences, together with a Graphics designer and represent some part of ISS and Columbus. Each of the elements has been designed to be compatible with underwater operation by the youngsters, and also to be easy to transport.

The experience of real EVAs leveraged:
In order to better simulate the real conditions in which astronauts operate, Planète Sciences staff and volunteers have interviewed three professional:

- Michel Viso, doctor in astro-biology within CNES: candidate for astronaut selection in 1985, he took part to pool trainings during at that time and later to assist other astronauts.
- Philippe Perrin, French astronaut, who flew with STS-111.
- Story Musgrave, American astronaut, who flew six times on space shuttles; he has been the leader for space walks for 25 years.

The explanation and experiences they reported helped to better surround the difficulties met during trainings in the pool or during EVAs; they have been used to elaborate the leader's guidebook. They were also instrumental in the selection of materials to be used during the activity.

GPS Rally
The GPS Rally activity brings participants to understand how the GPS technology works and how satellites can help us with on Earth localization. The activity is divided in two sequences:
Sequence #1: the youngsters learn about the key Earth landmarks (real and virtual) and how they are used to localize objects on a map: longitude, latitude… They also discover about the triangulation technique used by the GPS receivers to process their coordinates on Earth. Triangulation is exploited at that time to discover the localization of the handheld GPS receiver they will use in the second part of the activity.
Sequence#2: the participants are given a GPS receiver to go on hints hunt in the neighbourhood. The hints have been hidden by the leaders and their coordinates have been recorded in the receivers. The hints consist in individual words to be inserted in crosswords in order to discover a new word. The youngsters form groups and look for the hints interpreting the direction to go from their current location and the destination recorded in the receiver.
The activity let the young explorers to take a different look at their area. Similarly, a different look at the way they experience their surrounding on a daily basis. The activity delivers useful explanations about the way GPS work, while this technology is being incorporated in devices of our everyday life: car, phone, handheld devices…thus, they appear less like "black boxes" the principle of which is not understood.

4-Promotion, impact and collateral effects of *Space in my City*

4.1 Large public

As part of its missions, CNES brings the young population to be citizens: through science and space education, to allow the youngsters to develop questioning and critics sense, to allow them understanding scientific news, the stakes of scientific and space innovation. The population reached by *Space in my City* could possibly become tomorrow's astronauts or engineer within CNES Among them, those who are the most involved have been given the chance to meet with the French junior minister for urban affairs, Fadela Amara. In 2008 they presented her with passion their "scientific discoveries"

The programme *Space in my City* has both a national and regional impact. National impact on politics and media (newspapers, TV news, radio). Regional impact: further to the week of activities offered by *Space in my City*, municipalities organize science mediation events: science festival, scientific projects – with or without Planète Sciences- meetings with actors of space world, school projects with the school administration…

4.2 The youngsters inside and outside their neighbourhood

Because *Space in my City* is installed at the heart of the underprivileged areas, the operation offers to the kids who stay there during their holidays, a chance to enjoy fun, innovating and motivating activities. Several activities, such as the GPS rally, or the setup of a giant fresco give them the opportunity to look at their neighbourhood from a different angle, to promote it. All the week long the youngsters take part to the activities, and in the week-end their work is promoted during a space fest: the projects are presented and the young engineers perform demonstrations. Municipality officials, Planète Sciences and CNES representatives attend this fest and take part to the promotion of the projects.

Every year, a national gathering is organized, in Paris, in November at the time of the national Science Festival. The projects developed by the youngsters, the youngsters themselves and *Space in my City* are commonly promoted. The gathering welcomes 2 youngsters from each City: they represent, in the capital, their underprivileged area and their projects. During 2 days, they visit science museums, monuments and present their projects. In 2008, this presentation tool place at the French Parliament in presence of its president Bernard Accoyer, the president of CNES, Yannick d'Escatha, and the minister Fadela Amara.

CNES

Fig.8 Youngster promoting their experience and projects to officials at the French Parliament

4.3 Local structures, social web

Impact of Space in my City during the week

The week-end days of *Space in my City* are dedicated to the promotion of the project during a science fest: the participants explain and demonstrate their projects. Rockets are launched, rovers are dodging in between obstacles and at night astronomy lights up the audience's mind. At that time, science is brought to the local population the same way as sports or arts are delivered as form of match, show or exhibition: sciences are becoming accessible to all, out of their holistic aura.

While academic failure rate is high in the underprivileged areas, the success of the youngsters with their scientific project gives them self confidence, promote them. They consider sciences and school under a new angle.

Development of activities in local social centres

Strasbourg's municipality and especially its district Hautepierre, hosts and actively takes part to *Space in my City* since its origin. Consequently, local social centres for youth and culture have set up a science club in 2008. The club is offering the youngsters to work on water-based projects. Every Wednesday afternoon a dozen of youngsters come freely to build new projects. The club is supervised by a leader from the social centre together with a science communicator from a nearby organization. Since 2006, Planète Sciences has trained 17 leaders from Strasbourg to science activities (rockets, robotics…) to let the social centres evolving in autonomy; in 2009 Planète Sciences will also deliver dedicated material.

Developing activities at school

Space in my City brings dynamism in the city, including within its services, up to the social centres and the local associations. A large number of partnerships are established between the municipalities and Planète Sciences; as for example, one of the schools of Romans-sur-Isère has developed a weather balloon project through the programme « Un Ballon Pour l'Ecole » (a balloon at school [6]) proposed by CNES and Planète Sciences.

Developing science activities within the city

Space in my City shines over the underprivileged area and demonstrates to the municipality the benefits gained to develop scientific activities with the youth and general public. The science fests organized in the week-ends gather all the contributors of the programme for they appreciate the results achieved and also to plan for future developments.

Several cities involved in *Space in my City* have been developing events dealing with sciences for the public: Science festival in Metz, lecture at FNAC in Mulhouse; social centres in Vaux-en-Velin, Douai and Amiens offer now scientific activities; a permanent structure has been established in Alès, to host sciences-related exhibitions and activities all the year long.

5-MORE SPACE

The success of *Space in my City* can be measured by its local impact as described in previous section, but also by its media coverage, the number of youngsters involved, the geographic extend… The table below is a short summary of the past 5 years operation of the programme:

Year	***Cities***	***Participants***	***Distance travelled (km)***	***Permanent staff/year***
2005	5	2'000	2'000	0.5
2006	10	4'000	4'400	0.5
2007	17	10'000	7'500	1.2
2008	21	12'000	8'700	1.5
2009	19	N/A	*Est. 7'000*	1.5

Table1: *Space in my City* numerical summary

Fig.9 Geographical coverage of *Space in my City*

Perspectives

Since 2005, *Space in my City* grows to offer scientific and space activities to more and more underprivileged areas in France. With the support of national institutions among which CNES and with the coordination of Planète Sciences, the programme proved it is a unique way to let youngsters discover about scientific techniques and methods, during original and fun activities which are promoted locally, regionally and nationally. In order to pursue its development, *Space in my City* will:

- Strengthen its logistics organization (equipment, documentation),
- Improve and develop new activities and projects thanks to the work of volunteers supported by experts with professional experience in space.
- Extend its reach to cities in Europe within few years
- Extend its reach to new areas where youngsters hardly have access to science education: rural areas, small cities…

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