Christophe Scicluna,
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Anne Serfass-Denis
Nicolas Pillet
present:

SCIENCES EDUCATION WITH PLANÈTE SCIENCES: A SQUADRON OF TOOLS AND PROGRAMMES TO GO ON SPACE CONQUEST

IAC 2008 Glasgow

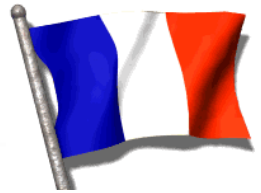
cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

Planete Sciences

PLANETE SCIENCES & CNES: A PARALLEL EVOLUTION

1961

1962



2002

1977

ORIGINAL MISSION: SUPPORT TO AMATEURS







PLANETE SCIENCES TODAY

Associations
Network
Techniques
Promotion
Sciences
Activities
Europe
France
Practical
Experimentation
Youth
Project
Safety
Clubs
Leisure
Management
Programmes
Team work
Exchanges
Events
Contests
Workshops
Volunteers
Pedagogy
Summer camps
Partners
Ministries
Organizations
Space activities
Meteorology
Energy
Astronomy
Environment
Robotics

SCIENCES EDUCATION WITH PLANETE SCIENCES: TOOLS & PROGRAMMES TO GO ON SPACE CONQUEST

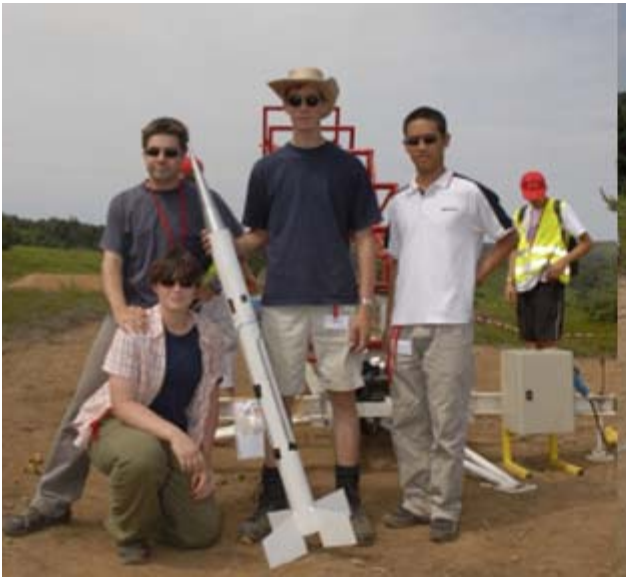
SPACE CLUBS: WHO ARE THEY ?

SAME PASSION




SETS... FACIL... ESIEE ESPACE... EUREKA+... ESO... AERO IPSA... UCG...

SAME MOTIVATION



FIRST STEP TO SPACE: WATER ROCKETS

Because anyone can be a rocket scientist!

1'000s rockets each year

WATER ROCKETS

From 6 years old, build a basic rocket from soda bottle and launch it to discover about action-reaction principle, stability and safety.

0.1km

At school, in a summer camp, in a club

FIRST STEP TO SPACE: MICRO-ROCKETS

Because anyone can be a rocket scientist!

50'000 rockets each year

MICRO-ROCKET

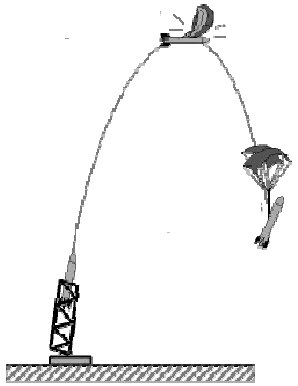
From 8 years old, design and build a small rocket from cardboard, plastic, and expect a flight above 100m.
Experiment and learn about flight mechanism, stability in full safety.

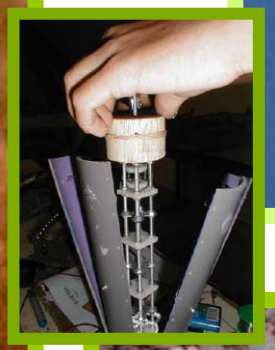
0.2km

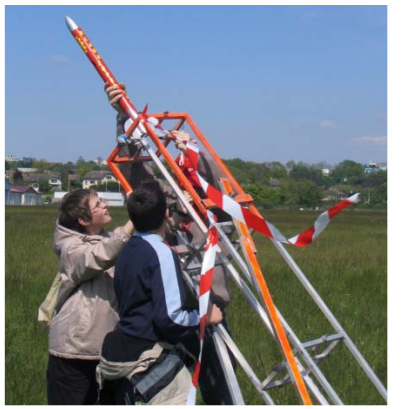
At school, in a summer camp, in a club

A STEP HIGHER: MINI-ROCKETS

Because space must not remain a dream!







120 rockets each year

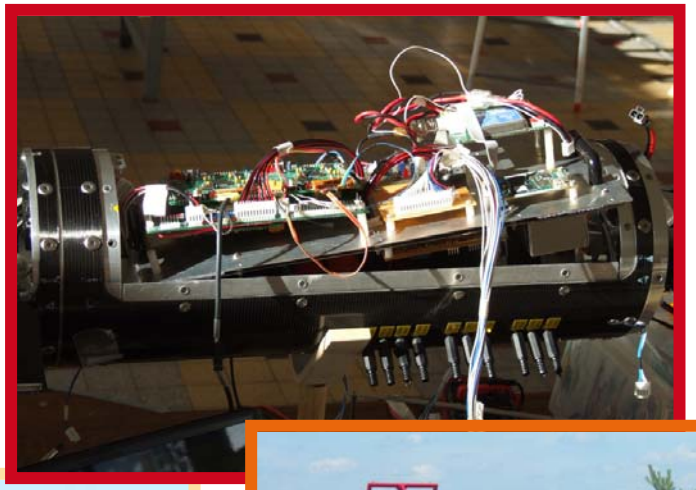
MINI-ROCKET

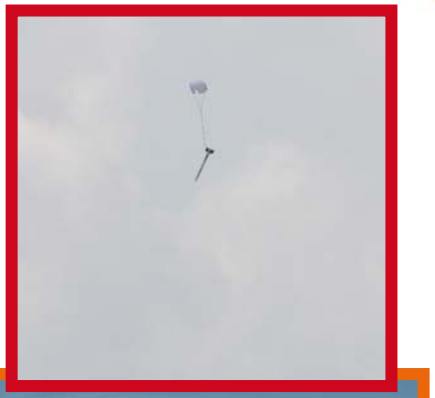
From 14, team up to design and build a stable rocket capable to reach 600m with ejection of a slowing down system. Deal and experiment with mechanics, electronics.

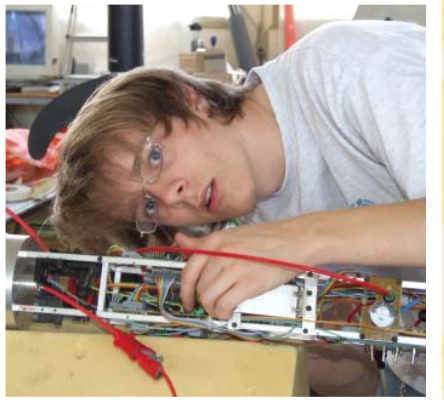
At junior-high school, in a summer camp, in a club

REACHING THE CLOUDS: EXPERIMENTAL ROCKETS

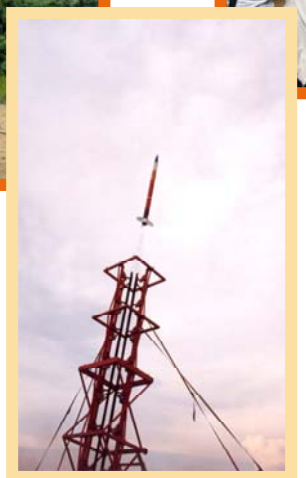
Because space must not remain a dream!







20 rockets each year



EXPERIMENTAL ROCKET

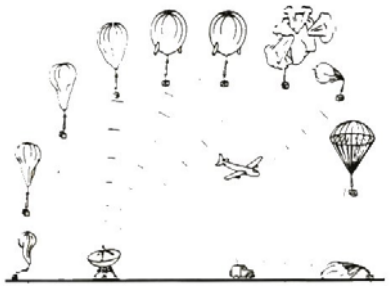
From 16, team up to design and build your own 2m tall sounding rocket, including telemetry, and process data collected at 1.5 km.

1.5km

At high school, at university in a summer camp, in a club

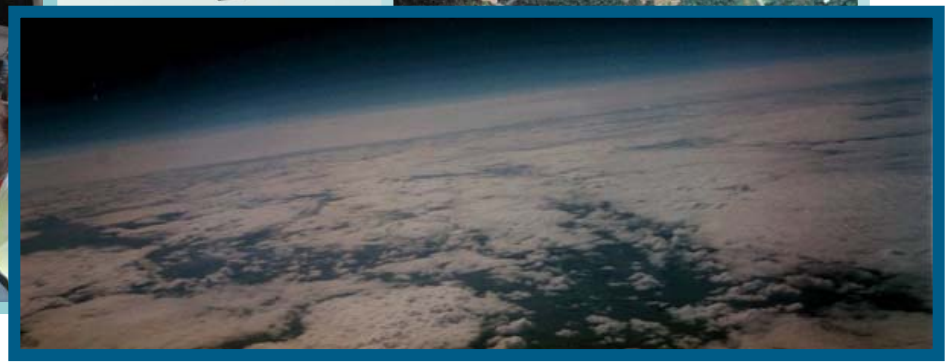
FLIRTING WITH SPACE: WEATHER BALLOON

Get a bird's eye view, and more!



150 balloons each year

30km



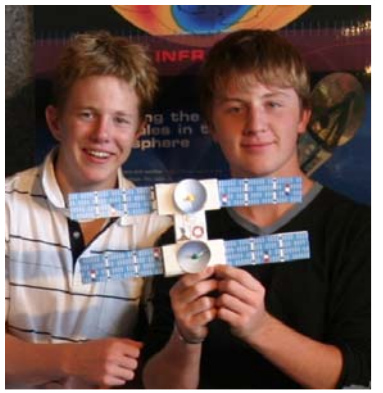
WEATHER BALLOON

From 10, team up to design and build experiments to be carried under a probe, flying above 30km. Learn about Archimedes, electronics, meteorology...

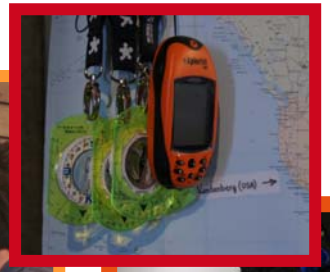
At school, at university
in a summer camp, in a club

NEED MORE SPACE?: WORKSHOPS

A panel of space-related workshops



100s of workshops each year



WORKSHOPS

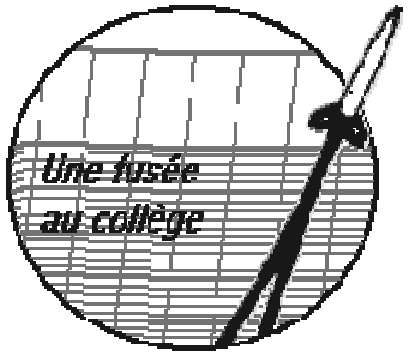
- GPS Safari
- Build your satellite
- Mission satellite control
- Space art fresco
- Space oceanography
- Mars rovers

0.1km

At schools, at holiday camps, at public events, in sensitive urban areas

NATION-WIDE PROGRAMMES: A ROCKET AT SCHOOL (UFAE)

A space-related pedagogic school programme



20 schools,
90 projects
each year

UFAE

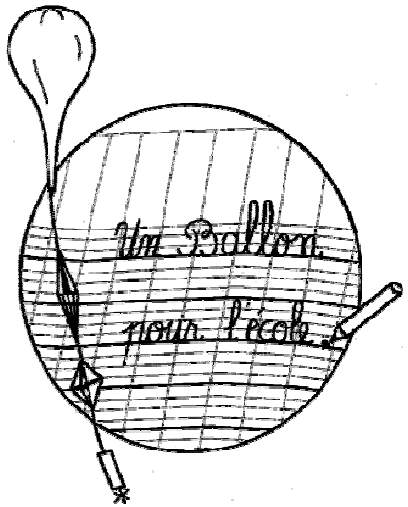
Deal with mathematics, physics, mechanics, electronics, media... within a team, all along the school year, to build your mini-rocket.

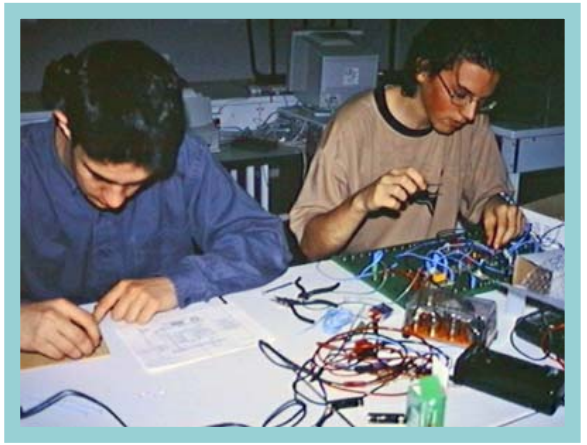
0.5km

At junior-high school, at high-school

NATION-WIDE PROGRAMMES: A BALLOON AT SCHOOL (UBPE)

A space-related pedagogic school programme





30km

140 schools each year

UBPE

Deal with mathematics, physics, electronics, meteorology, media... within a team, all along the school year, to build your balloon's experiments.

At school

SPACE PROPAGATION: TRAININGS

Spread the practices, not just the word

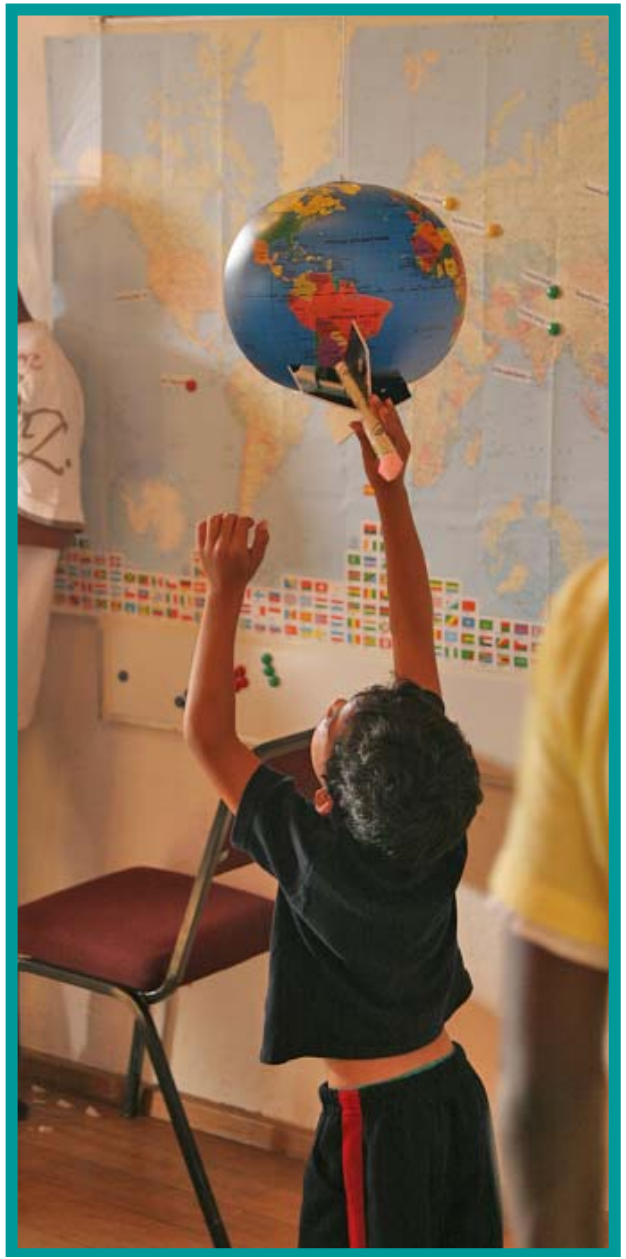
30 sessions each year

TRAININGS

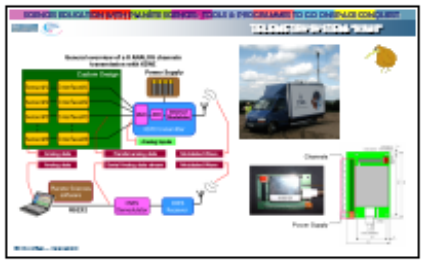
To master rocket flight mechanics, to master safety, to launch rockets, to become a telemetry expert, to learn about pedagogy, to become a trainer.

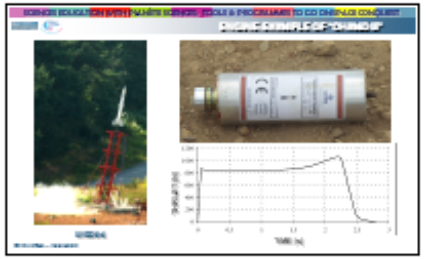
SPACE CONQUEST !

- Develop sciences and techniques scholarship
- Develop space culture and increase space awareness to ease space projects funding from state or private organizations
- Fly ever higher and achieve space dreams



BACKUP SLIDES: DO YOU WANT TO KNOW MORE?





I WANT TO MAKE A ROCKET...

- Do **NOT** do it yourself !

E-MAIL

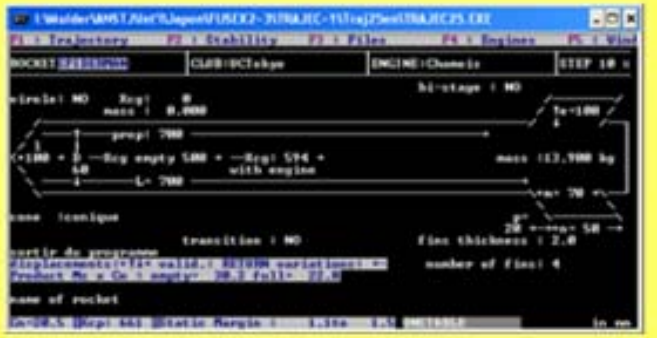
Planete Sciences

une aventure pour les jeunes

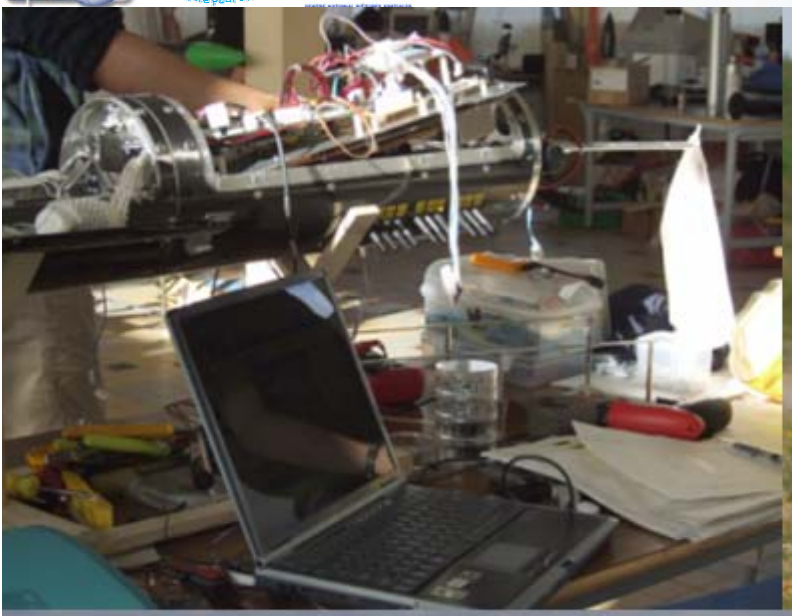
cnes

CENTRE NATIONAL D'ÉTUDES SPATIALES

- What do we provide ?



DID YOU SAY EXPERIMENTAL ROCKET ?







SCIENCES EDUCATION WITH PLANETE SCIENCES: TOOLS & PROGRAMMES TO GO ON SPACE CONQUEST

FROM DREAM TO REALITY

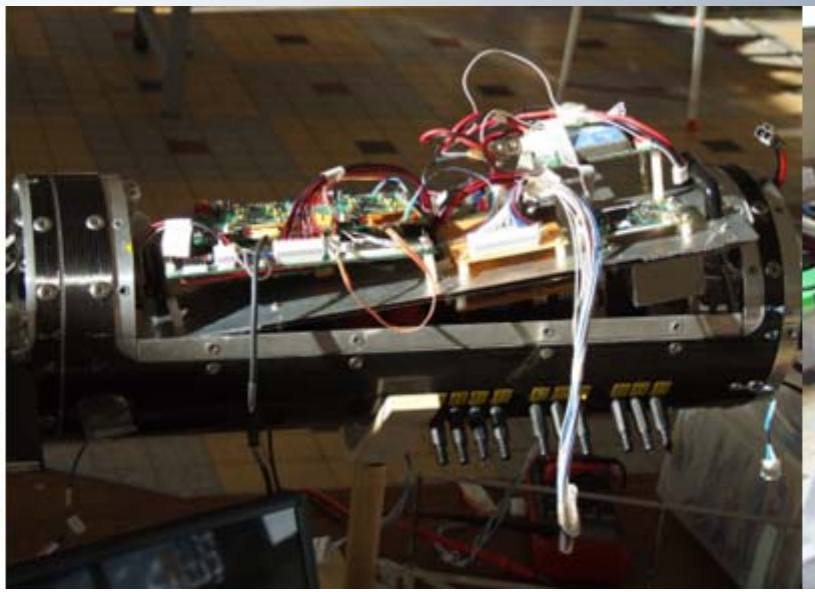
Registration
Clubs
Youth
Project
Experiments
Definition
Team work
Management
Skills
Safety
Pedagogy
Constraints
Simulation
Stability
Tutorials
Calibration
Telemetry
Recovery
Integration
Interpretation
CNES
Advices
Partners
Exchanges
Volunteers
Reviews
Launch
Controls
Campaign

SCIENCES EDUCATION WITH PLANETE SCIENCES: TOOLS & PROGRAMMES TO GO ON SPACE CONQUEST

A LAUNCHING CAMPAIGN: A TEAM

Pyrotechnics, Safety, Telemetry, Energy, Recovery, Coordination, Entertainment, Transport, Welcome, Controls, Expertise, International relations, Equipment, Launching, Public, Organisation, Logistics, Partners....

A LAUNCHING CAMPAIGN: FINAL PREPARATION



Debug ... Controls ... Approval ... Set up in pad ...

A LAUNCHING CAMPAIGN: COUNTDOWN & FLIGHT

Engine...

Countdown ...

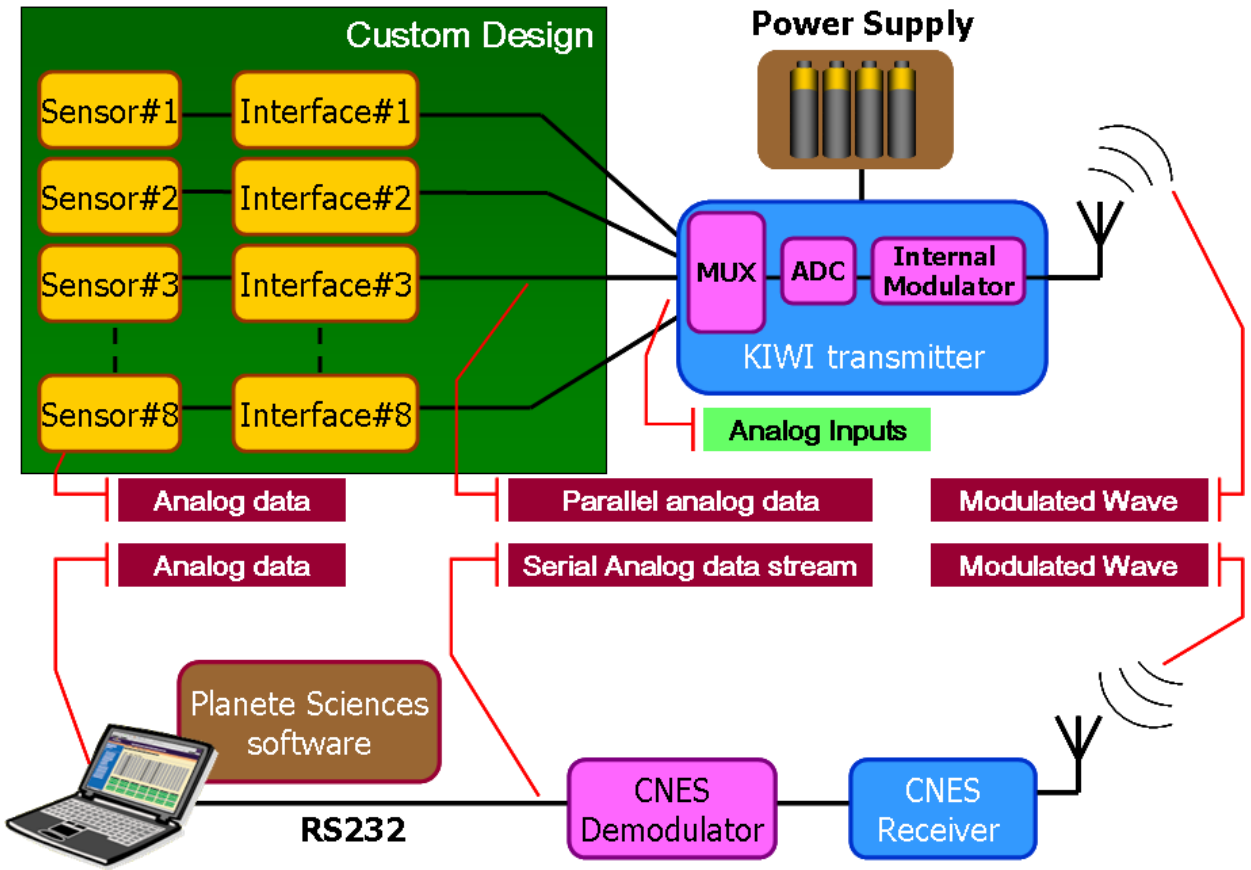
Launch...

Parachute...

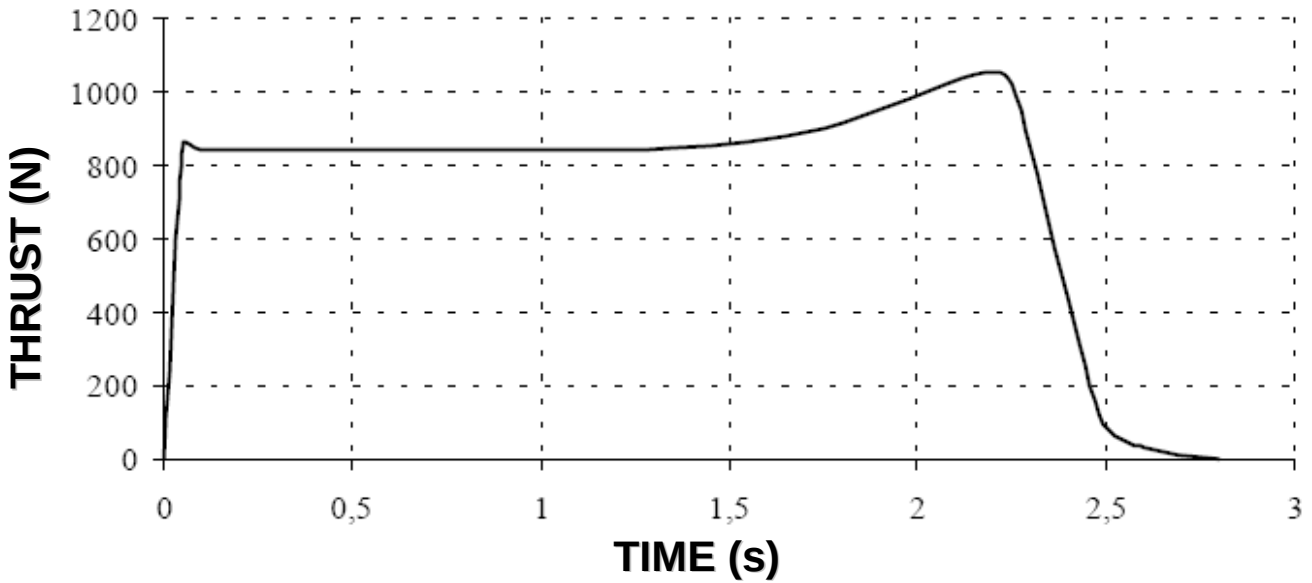
Recovery

TELEMETRY SYSTEM: "KIWI"

General overview of a 8 ANALOG channels transmission with KIWI



ENGINE: EXAMPLE OF "CHAMOIS"



UCG06

UFAE

Formations

Minif

Micro

IAC-08-E1.2.1

SCIENCES EDUCATION WITH PLANÈTE SCIENCES: A SQUADRON OF TOOLS AND PROGRAMMES TO GO ON SPACE CONQUEST

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From Planète Sciences

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From CNES

59th International Astronautical Congress
29th Sept-03rd Oct 2008/Glasgow, UK

SCIENCES EDUCATION WITH PLANÈTE SCIENCES: A SQUADRON OF TOOLS AND PROGRAMMES TO GO ON SPACE CONQUEST

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Space Culture Division, CNES, France

ABSTRACT

Since 1962, and with the support of CNES and major aerospace industries, the French non-profit organization Planète Sciences has been providing young amateurs with facilities, tools and programmes to make their dream fly.
Young space conquerors are proposed to get hands on projects ranging from micro-rockets to experimental rockets but also stratospheric balloons and Cansats. The projects proposed by Planète Sciences are performed within safety constraints and come with pedagogic and technical support and reviews from volunteers, several times during the project lifetime. They involve teamwork and the development of management and experimental process. They are made available to the widest and most popular range of participants and are the most important space outreach programs in the country. Planète Sciences is managing programmes, trainings, workshops, club projects in France and beyond.

1-INTRODUCTION

1.1 CNES, the French space agency established in 1961, is a public organization in charge of the development and management of the French space programmes. Its mission is to guarantee access to space capability and its use for all national and European needs. This includes support to space amateurs. Under the control of CNES, Planète Sciences, a non-profit organisation, was formed in 1962 to provide assistance to space clubs for the design, manufacturing and launching of the experimental space rocket projects.

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 [1]. 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* [2], *First Lego League*, *La nuit des étoiles* (the night of the stars), the national rocket launching campaign (R2E: Rendez-vous Espace Etudiants).

1.3 Support to amateurs

It originally started with space activities at a time when the space conquest was leading passionate people to build amateur rockets. Several of them lost their lives while tuning rocket engines made of World War II military ammunition collected from battlefields or by using approximate chemistry formulae.

To prevent further accidents, the French government prohibited any non-professional astronautic activities and assigned CNES to provide assistance to amateurs. The necessity to set specific programs for the youth emerged from the fear that a total prohibition would not eliminate the risk of accidents but on the contrary would promote clandestine usage. CNES, for practical reasons, could not have formal relations with individuals and therefore invited them to gather in clubs thus contributing to the establishment of an association named "Association Nationale des Clubs Spatiaux" (ANCS), now Planète Sciences (Fig. 1).

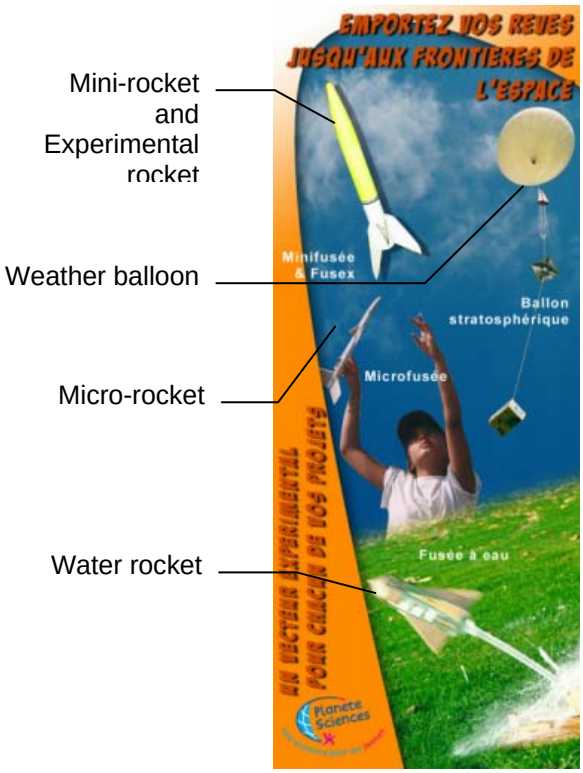

Fig.1: Space activities at Planète Sciences

Influenced by the professional background of its creators, who were members of the industrial world, the association developed avant-garde pedagogical methods that are based on concepts such as:

- To introduce youth to science and techniques through practical activities,
- To develop these practices as leisure activities,
- To promote teamwork,
- To offer youth the opportunity to engage in exciting projects such as rockets, where the tuning complexity naturally justifies the necessity to learn,
- To introduce youth to project management and experimental process since, in order to be successful, the capacity to manage a project is as important as the technical knowledge itself.

2-FIRST STEP TO SPACE: WATER ROCKET & MICRO-ROCKET

With micro-rocket or more recently water-rockets, available from the age of 7, the youngsters are brought to design and manufacture their first rocket and to learn the basics of aerodynamics, flight stability, propulsion and safety procedures. This can be performed within a couple of hours or days and the altitude reached by the rockets is from 50 to 200 meters, before falling back under a parachute.

Fig.2: Rocket scientist

Micro-rocket, propelled by A, B or C motors (from 2.5 to 10 N.s) are mainly made of cardboard, measure from ~15 cm to ~40cm and can reach 200m high with a 200km/h lift off speed (Fig.2) It is the ideal tool to experiment and to understand what it takes for a rocket to be stable and fly straight up. Kids are given the chance to handle tools such as glue gun or drill and raise them with more responsibility. Because safety is the golden rule of Planète Sciences' activities, micro-rockets motors are not part of any experiment. They are supplied from an approved manufactured, retailed by Planète Sciences and are launched by and certified adult (18 and above). The micro-rocket certificate (*agrément microfusée*) can be obtained from Planète Sciences after having successfully attended a 25 hours training session. The training deals with manufacturing, rocket flight, stability experimentation and evaluation, safety rules, launching campaign organization and pedagogy. Trainees are given a 75 pages reference book [3] gathering knowledge about propulsion and stability, safety, manufacturing techniques (basic rockets, multi-motors or multi-stage rockets, ignition box) and pedagogy (experimental process). Trainees then master the fundamentals to hold workshops and launch rockets in safety conditions with kids. Each year, about 50'000 micro-rockets are launched in France, a million since 1980.

Water rockets spread in the 90's: they are cheap, easy to build from soda PET bottles and easy to launch. Because it is not under the control of any regulation, Planète Sciences developed documents to guarantee safety, but also to highlight the pedagogic interest of this tool. Like other countries in the world, water rocket workshops are proposed by Planète Sciences to bring kids to discover about space, sciences and techniques through the excitement of a simple jet of water propelling their rocket in the air.

Fig.3 Water rockets: science and fun

3-A STEP HIGHER: MINI-ROCKET & EXPERIMENTAL ROCKET

When a team is willing to start a rocket project its first step is to make contact with CNES through Planète Sciences. The three parties are bound by a moral contract, which may be summarized as follows:
the tuning of a rocket engine is very dangerous for novices and this practice is prohibited by national regulations; alternatively, clubs are invited to design and build a rocket for which CNES provides with both a professional quality powder engine and the launching facilities. From its side, Planète Sciences organises technical assistance, the launching campaign itself and ensures that the activities fall within the European regulations.

The efforts of the clubs are thus focused on their mission which is the experimental content of the payload and the mechanical structure of the rocket. The set up of the propeller and the rocket launch are the responsibility of a professional pyrotechnician from CNES.
A typical experimental rocket is 2 meters long, weighs about 10kg and reaches heights of about 1500 meters as shown in Fig. 4. About twenty rockets of that type are built and launched every year by club members from ages 14 to 25, who come from regions across France,

and also from Japan, among regular foreign participants.

Before flight, a typical mini-rocket weights 1 kg and measures about 100 cm, with a 500 m altitude reach; a slowing down system must be deployed in order to make it land safely. The up flight lasts 20 seconds and fall may last a minute or more. The flight is stabilised thanks to 3 or 4 fins located at the bottom of the rocket. Initial acceleration is about 10 G.
Control procedures are also carried out for rockets, according to specifications. Rockets are made of PVC or even cardboard and are designed according aerodynamics constraints. For youth, the main experiment is to imagine and to achieve a way of extracting parachute at the right moment. But rockets may also be fitted with acceleration sensors, sun detection (to deduce the rotation of the rocket)…

Fig.4 Rocket launching by
the French club CLES-FACIL

Club members willing to turn their dreams to reality can register their rocket project from early October of each year. They are required to prepare for the definition of the mission and the experiments it would require. For that purpose, a set of online resources are provided by Planète Sciences, which will help the clubs in the development of their project:

- A project definition and summary spreadsheet, regularly updated, serving as a link between the clubs and Planète Sciences for the technical data of the project.
- The design constraints: a wide set of rules focusing on safety and pedagogy. It includes mechanical constraints (stability margins, dimensions, resistance to stress), experimental requirements, recovery systems, ground localization, telemetry systems and compliance with regulations and standards (frequency spectrum, modulation schemes), rocket implementation and interpretation of the recorded results [4];
- A dedicated stability calculation tool [5];
- Technical documentation about the motors provided by CNES [6];
- A technical manual about the KIWI telemetry system developed by CNES for the purpose of such projects led by clubs [7];
- Technical tutorials dealing with electronics, sensors, parachutes as well as team and project organisation;
- Previous years' projects reports.

All of these resources are prepared, updated and translated into English by the volunteers of Planète Sciences.

The volunteers also provide technical assistance in the following manner:

- On the phone every Wednesday evening while they gather at Planète Sciences' premises,
- Online through a web-based forum,
- Live, once a quarter during meetings with the clubs.

Planète Sciences sets up the launching facilities depending on the needs of the clubs. Regional launching campaigns are organised for mini-rocket, while for experimental rockets, the national

launching campaign (R2E) takes place in the heat of summer under the supervision of CNES and the assistance of the army.
Dealing with the R2E, from the launching pad to the details of accommodation, everything is arranged to host about 30 mini and experimental rockets and more than 300 young amateurs, either club members or volunteers in charge of the organization.

The launching campaign is possible thanks to the involvement of the large number of volunteers (more than 40) and the trust of CNES authorities. Professional pyrotechnicians and ground safety managers from CNES assist the volunteers. CNES funds the launching campaign and supports the development of student space research programmes, such as PERSEUS for nano-satellite launchers, or CANSAT.

Fig. 5 The launching site set up at the national campaign

Fig. 6 From 14, teenagers handle their own mini-rocket project

Fig. 7 Even Japanese Space clubs enjoy the launching campaign: why not you?

4-CLOSER TO SPACE: STRATOSPHERIC BALLOON

The Stratospheric Balloon team members have to design and build all the experiments of their choice, which take place in a basket hanging below a weather balloon.

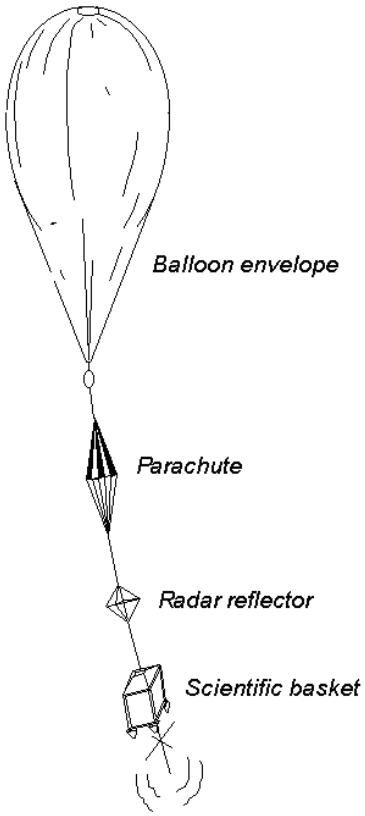

Fig. 8 Stratospheric balloon flying chain

Reaching very high altitude (up to 40 km, enough to observe the round shape of the planet), this vector allows studying the different layers of the atmosphere and its characteristics, to perform remote sensing, land recognition, image processing and other rared-atmosphere experiments. A dedicated telemetry transmitter is provided by CNES for the young space quasi-travellers assess their first results.

A reference document called *"Cahier des charges"* [8] describes the technical constraints baskets should comply with to be compatible with legislation and the loan of collective equipment. Other documents develop some specific technical aspects: flight mechanism, atmosphere properties, telemetry and methods for project management. These documents are written taking care to be as clear as possible in order to be understood by youth themselves and are regularly upgraded taking account of stated remarks.
Connected to documentation, the following equipment is made available to clubs by CNES: a balloon probe envelope, a radar reflector, a parachute, an helium tank, a suitcase containing lift-off equipment and if requested by the project, a KIWI telemetry receiver set [6].

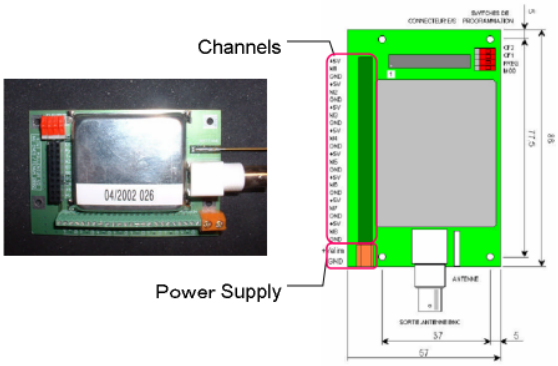

Fig. 9 KIWI transmitter

This equipment is regularly used for professional meteorology soundings but the transmitter that has been designed on purpose for youth with special care to make it cheap and easy to use. Typically, the balloon's volume is about 5 m^3 when lifted off and may carry a 2.5 kg basket up to 25 km; then it bursts and the parachute slows its fall. A typical flight lasts 3 hours: the basket flies with the winds and may land 250 km away from its starting point. The balloon flies high enough to reach troposphere where onboard sensors may record temperature and pressure close to spatial conditions. The balloon activity is fully compatible with aeronautics regulations, which served as a basis of the write up of the main rules described in the specifications stated by Planète Sciences and validated by CNES.

5- WORKSHOPS: BRINGING SPACE THRILL AND DREAM TO EVERYONE

Workshops are conducted by Planète Sciences all along the year for kids of all age groups: in schools, during holiday camps or public events, in sensitive urban areas. These workshops are triggering kids' imagination and let them create, invent and interact while they are passively learning notions or techniques.

5.1 Build your satellite

This workshop is addressing the satellite questions: what is it, what is it used for, where is it…how it works? During a 1 to 2 hours session, kids from 6 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.


Fig. 10 Happy satelitte Engineer

Space environment constraints are introduced (orbits, temperatures, ground transmission). And for groups above 12 years old, mass and energy matters are bringing the engineering complexity to the workshop. Indeed, considering that each of the building blocks has a given mass and power consumption, that only solar panels provide energy and that real launchers have limited launching capabilities, young engineers have to solve the mass/energy equation, for the satellite they have dreamt about finds a room in a launcher. Scales and weights bring excitement to the workshop (just alike a wet-market game) but with real purpose. Kids discover how puzzling engineering can be.

The link with ground stations and the help and rescue possibilities of satellites are then illustrated thanks to a dedicated active model connected to a PC through wireless transmission. Following a card-based game, emergency signals are sent to the model by a team in trouble-deep; signals are "reflected" (simulated by wireless transmission) to the ground station (simulated by computer) and the rescue team is triggered to come and save and rescue the other endangered ones.

5.2 "Locaterre" – Locate on Earth

The title of the workshop is a play on words: "Locataire" is the French word for tenant, while "Locaterre" is a composition made of *Localisation* and *Terre* (Earth): *locate on Earth*. Kids are here invited to look down at themselves, earth inhabitants, thanks to space tools. Compass, GPS receivers, Earth and regional maps, satellite pictures are the tools used all along this 2 to 3 hours workshop. Youngsters from 8, learn about coordinates, longitude, latitude and consequently to read a map with coordinates. This is efficiently reinvested during a couple of dedicated board games or in-field hunts with GPS receivers.

5.3 Mission Control

At least 4 people are required for the 30 minutes missions: two of them will play the role of the satellite, while the two other ones will be standing at the ground station and will send orders to the satellite.

The workshop involves the KIWI transmitter connected to a GPS receiver: the device is carried by the satellite, evolving outdoor. The ground station receives on a computer the GPS data transmitted and therefore can observe the satellite's movements on a geo-localized map. Each team is provided with a walkie-talkie, a compass and, mission-depending, a handheld GPS receiver. The ground station team sends directions to the satellite using walkie-talkie. The satellite team follows (or at least tries to follow) the directions and doesn't need to report: its path is displayed on the ground station's screen. Orders are given until the mission is complete…or the satellite is completely lost! Teams then exchange roles expecting to do better than their counterpart.

Mission control brings kids to act like satellites while, at the same time, they actually make use of satellites! This is great fun but players realize how difficult unidirectional communication can be, thus requiring well defined rules (codes) and a lot of redundant orders; they also discover that reading/following directions involving compass is not such an easy science to master. They feel the precision achieved through satellite positioning. Several missions are available involving a screen pattern to follow, or reaching exact coordinates. These missions somehow reflect actual satellite's life sequences.

5.4 Earth Observation Balloon

Yang Liwei, the first Taikonaut, created a mini revolution for Chinese schoolbooks when, after his historical flight in 2003, he reported he couldn't

see the great wall from space. Space detection and by extension space art have always fascinated space fans. Satellite resolutions have reached 1m and Google have made their images freely available to the public. The Earth observation balloon workshop intends to give kids the chance to enjoy a mix of tele-detection and space art.
The purpose is to recognize their environment, from space, thanks to pictures taken from a camera lifted at 100m high with a helium balloon. On the ground, the kids (12 and older) are carefully recording coordinates of remarkable places.

Fig. 11 Unmanned static Earth Observation Balloon

Once bird's eye pictures are taken, they are processed and mosaic-ed through dedicated software; using the GPS coordinates recorded, kids start to recognize the different places and elements on the picture; they scale the picture and calculate for surfaces. When no remarkable element is lying below the balloon, kids can lay large pieces of coloured cloth on the ground, to form a drawing. Space art is then bringing the creative excitement to the scientific experiment.

Fig. 12 Space art shot from 100m by Earth Observation Balloon

5.5 A deep watch into oceans

How to study marine streams? How to evaluate how winds influence them? How are they affected by the temperature? Scientific satellites, like Topex-Poseidon and Jason have brought answers to all these questions. Through this dedicated workshop, kids are invited to understand the key principles that rule marine streams through experiments and to reproduce some experiments the in the same way as the satellites do.

5.6 Mars robot

This workshops offer participants to:

- Discovering the basics of electricity,
- Getting introduced with the main parts of a robot,
- Becoming aware of physics and mechanics laws.

From 8 years old, and during 3 hours, kids are invited to build their own autonomous robot from an electric gearbox kit, cardboard and imagination. Alike their cousins sent on the surface of Mars, these robots will be eventually capable to detect and avoid obstacles.

5.7 AND MANY MORE….

On top of the traditional but still very successful water rocket and micro-rocket workshops, Planète Sciences members have developed a large panel of workshops to address both the needs to explain space environment, but also the growing enthusiasm of the general public while space tourism is ringing the start of a new era for our space-based society.
Enter the backstage of a launcher set up with the Ariane5 discovery room, become an astronaut with the dedicated training or experience a satellite repair mission in a pool; experience tele-surgery and unveils a full range of satellite applications…

6- PROGRAMS & TRAINING

6.1 UBPE & UFAE

Programs named *UBPE* and *UFAE* are taking place at school either during official tuition times or during post-curricular activities proposed by teachers. Most of time, teachers fill in a spontaneous request form describing the educational purpose they want to achieve. Once the application is accepted by Planète Sciences (mostly based on youth motivation and teachers involvement), a volunteer is assigned to the project team: he acts as a technical advisor, who visits the group several times during the school year to ensures the best development of the project.
He advises the teacher about methodology but never aims at replacing him. During his visits, the volunteer works either with the group itself or with the teacher to help him preparing lessons.
Volunteers are mainly students or young adults working in technical fields.

UBPE has started in 1992; it is proposed to a wide scholar public (from primary school to high school). It is managed by a national responsible at Planète Sciences and relayed by regional divisions. A typical project will be composed of 3 to 4 experiments, plus the basket itself: 25 to 30 kids can be involved in the project.
From 30 schools for the first edition, the program is now proposed to 130 to 160 schools each year; half of these schools are proposed the program again, on purpose

UFAE has started in 1999 and is dedicated to the same public as *UBPE*; its overall organisation is also similar, carried out by volunteer and managed by an employee from Planète Sciences. Today, about 20 schools are engaged in this program for a total of 90 projects.

During the school year, with the same phases and methodology as already described, groups of 5 to 10 youths are working on the achievement of a mini-rocket.
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Fig13. Media frequently cover the release of a balloon project

Several documents are available to teachers and pupils; written by volunteers and validated by CNES, they explain the purpose of the programs, the way they are managed, and give all information needed to bring teachers self-confidence about such complex-looking projects.
The programs meet the annual scholar cycle. At the beginning of the year, teachers are even invited to a one-day information meeting organised locally by Planète Sciences.
Teachers may benefit from these programs to develop collateral cultural projects: visits of industrial site or museum, thematic studies connected with history, introduction to new concepts.

6.2 Trainings and pedagogy

Projects and programs would not take place without the contribution of volunteers, teachers and science communicators. Because they need to be taught about the techniques and pedagogy, each of the activities and programs comes with dedicated training sessions:

- *UBPE* and *UFAE* technical advisor
- Telemetry with KIWI
- Advanced telemetry and reception
- Aerotechnician (balloon release)
- Micro-rocket launcher certificate,
- Mini-rocket launcher
- Trainers training (to be sustainable)

Pedagogy is present throughout all of the trainings with the experimental process as one of the basic fundamental: seamlessly the following steps are crossed: Observation, Assumption, Experiment, Results, Interpretation, Conclusion. This ensures parameters to be clearly defined and isolated in order to achieve consistent results. Dream and game are not taken apart as we deal with youth and it is not rare to see a castle-shape rocket or a large lips shaped-balloon basket flying in the sky of Planète Sciences.

Fig.14 Students, teachers, leaders, parents: training contents are adapted

7-CONCLUSION

Planète Sciences is a non-profit organisation whose ambition is to contribute to the development of scientific and technical cultures among youth using pedagogical methods based on experimental methods and introduction to project management. Together with CNES, it brings sub-space projects to reality by proposing a safe and structured organisation to design build and launch rockets. The space experience, throughout rockets, balloons or Cansats, although sub-space, bring youngsters to achieve part of the dream that today becomes a reality with tourism. No doubt that with the new space travel opportunities more experiments will be carried out by young generations, to develop the thirst for scientific knowledge higher and farther.

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