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EXPLORA User Manual

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in collaboration with



Rymdstyrelsen
Swedish National Space Agency



Change Record

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1 ALWAYS READ THIS

1.1 User Manual

This user manual is a reference document that outlines the requirements and provides recommendations for participation in the EXPLORA programme.

The EXPLORA user manual is based on the SERA (Standardised European Rules of the Air) regulations and the ESM (Estrange Safety Manual) and is applicable only to the EXPLORA programme participants.

1.2 Definitions

Balloon envelope	The part of EXPLORA balloon giving the lifting force.
EXPLORA balloon	The complete integrated vehicle to perform the flight.
EXPLORA payload	Any system under the balloon envelope, also called “total suspended mass”.
EXPLORA experiment	The experiment developed by the EXPLORA participants.
EXPLORA participants	The selected high school student team and their teacher(s).

1.3 References

[1]	SSC Space, Estrange Space Center, Estrange Safety Manual, SCIENCE-60-4208, ver 10.0 (16Nov2023) Estrange Safety Manual (sscspace.com)
[2]	SSC Space, EXPLORA Proposal form, SSCDOC-308367960-38 (12May2026)

1.4 Abbreviations

AIT	Assembly, Integration and Testing
CRP	Campaign Requirements Plan
ETAG	Estrange Throw Away GPS
ESB	Estrange Safety Board
ESM	Estrange Safety Manual
FRR	Flight Readiness Review
GNSS	Global Navigation Satellites System
GPS	Global Positioning System
GSP-Q	Ground Safety Plan-Questionnaire
LT	Local Time
PTU	Pressure, Temperature, hUmidity radiosonde
SERA	Standardised European Rules of the Air
SNSA	Swedish National Space Agency
STEAM	Science, Technology, Engineering, Art, Mathematics



2 EXPLORA PROGRAMME

2.1 Programme objectives

EXPLORA is a Swedish national programme, dedicated to high school students, funded by SNSA, the Swedish National Space Agency and operated by SSC Space.

EXPLORA PRIMARY OBJECTIVE

Promoting STEAM is the way to prepare the next generation of researchers and engineers who will contribute to the development of innovation and competitiveness of the Swedish Space industry but also for other sectors such as transport, communications or environment.

Hands-on activities are a key enabler for the pupils/students to learn, understand, and try by themselves. Such hands-on activities are an excellent complement to theoretical education. This is why EXPLORA programme is a unique opportunity for the Swedish high school students and for Sweden to attract young people to education and professions in science and technology.

SECONDARY OBJECTIVE

International cooperation is a core part of EXPLORA. Indeed, nowadays, the Space domain is international and cooperation is an important asset to succeed. Therefore, pairing each Swedish team with an international team is an excellent way to learn about other cultures, ways of working, ways of communication, to learn how to conduct a project with distance and to practice English.

NOTE: In case of no possibility to pair a Swedish team with an international group, the Swedish team would still be able to be selected and benefit from the hands-on aspect of EXPLORA programme.

2.2 Programme concept



Figure 1 - EXPLORA programme concept “from classroom to Stratosphere!”



- 1 EXPLORA experiment = 1 group of participants from one high school with their teacher(s),
- each group of students is paired with an international group from a foreign school (the Swedish school can already apply with a twinned school, or the programme can help finding a school in a foreign country),
- 1.8 kg are available for EXPLORA experiment,
- Flight to an altitude range of 25-35 km,
- Flight duration is 1-3 hours,
- EXPLORA participants are responsible for the objectives and for the experiment development (designing, building, testing),
- EXPLORA participants and SSC Space have several project reviews during the cycle,
- EXPLORA participants come to Esrange Space Centre to release the balloon and recover it,
- EXPLORA participants are responsible for analyzing the data and presenting the conclusions.

2.3 Programme organization

The financial support of the EXPLORA programme is the responsibility of the Swedish National Space Agency (SNSA).

The scientific evaluation of the EXPLORA proposals is the responsibility of SSC Space with possible contribution from SNSA.

SSC Space programme manager is the primary point of contact for the EXPLORA participants. The primary point of contact may provide answers to programmatic, technical, and reporting queries posed by the teams.

SSC Space provides programme management, campaign management, launch operations, balloon preparation, and flight equipment.

2.4 Programme timeline

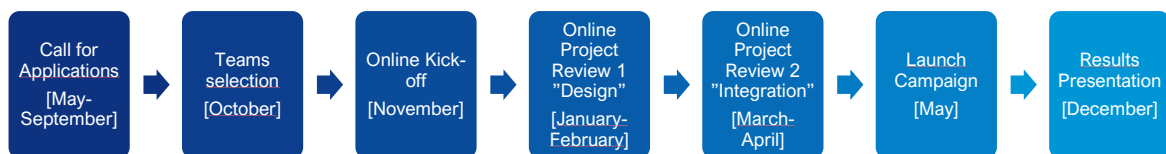


Figure 2 - EXPLORA programme milestones



2.5 Programme documentation

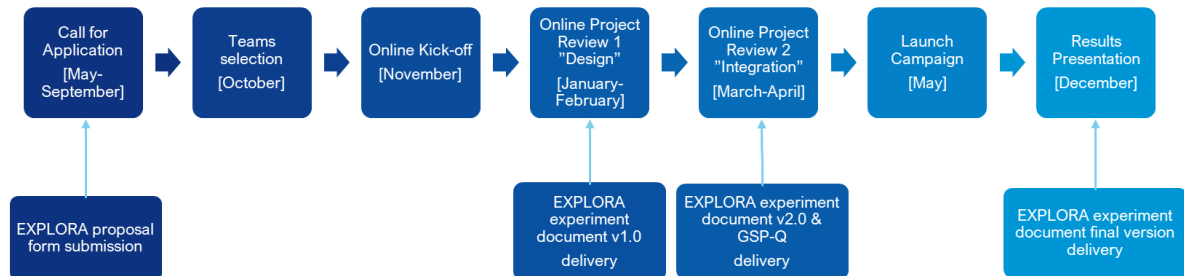


Figure 3 - Documentation delivery

2.5.1 EXPLORA experiment document

During the whole programme, this is the main documentation used by EXPLORA participants to describe their experiment. This document provides SSC Space with all important information about the experiment.

Three versions should be provided by the EXPLORA participants, each of which providing greater detail in comparison to the previous version:

- v1.0 at Project Review 1 “Design” (*to be delivered 1 week before the review*),
- v2.0 at Project Review 2 “Integration” (*to be delivered 1 week before the review*),
- final version after the campaign to present the experiment results and lessons learnt (*to be delivered 1 week before the Results presentation*).

The EXPLORA experiment document is responsibility of each EXPLORA team.

The EXPLORA experiment document form will be provided by SSC Space.

2.5.2 Campaign Requirements Plan (CRP)

The CRP is responsibility of SSC Space programme manager and incorporates information from the EXPLORA experiment document.

The document details the following information:

- EXPLORA experiment description (extracted from the EXPLORA experiment document),
- Flight requirements,
- Launch site requirements,
- Preparation and tests activities during campaign,
- Timeline and countdown operations.

The CRP is responsibility of SSC Space.



2.5.3 Ground Safety Plan-Questionnaire (GSP-Q)

A few weeks prior to the campaign, the Esrange Safety Board (ESB) requires detailed inputs for the campaign risk analysis and safety evaluation. Therefore, the EXPLORA participants are requested to fill out the Ground Safety Plan-Questionnaire including all required details.

Each EXPLORA team shall deliver a GSP-Q at v2.0 at Project Review 2 “Integration”.

The GSP-Q form will be provided by SSC Space.

2.6 EXPLORA participants’ role

The EXPLORA participants are responsible for developing and providing the EXPLORA experiment and necessary support equipment. SSC Space can help with many of these issues, but the participants are responsible for ensuring that these are organized in a timely manner. They are also responsible for ensuring that the experiment conforms to all requirements stated in chapter 5.



3 EXPLORA BALLOON

The balloons used for EXPLORA are based on weather balloons. Many of those balloons are released every day in the world to collect temperature, pressure and humidity data. At Esrange, SSC Space also releases such balloons regularly as part of the launch process for suborbital rockets.

The weather balloons can reach an altitude range of 25-35 km for a total experiment mass of 1.8 kg and for a flight duration of 1-3 hours.

3.1 EXPLORA flight configuration

EXPLORA balloon is composed of several elements that mounted together could consist of a flight train reaching 8 m long.

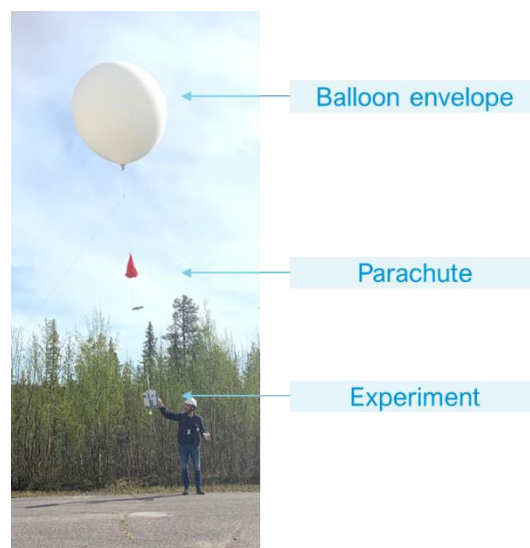


Figure 4 - Typical EXPLORA balloon flight train

3.1.1 Balloon envelope

The **balloon envelope** is made of rubber material with a thickness of a few microns. It is therefore a fragile system that should be handled carefully. The balloon is filled with helium, an inert gas, with lower density than air and easy to operate (contrary to hydrogen, a light gas but flammable). The balloon burst when reaching maximum altitude, usually 25-35 km.

The balloon envelope is provided by SSC Space.



Figure 5 - Weather balloon envelope

3.1.2 Parachute

The **parachute**, mounted directly to the flight train, is used to decrease the descent velocity of the EXPLORA experiment and maximize the chance of experiment integrity at recovery. The parachute has a surface of 1.5-2m². The parachute opens automatically after balloon burst.

The parachute is provided by SSC Space.



Figure 6 - Parachute

3.1.3 ETAG

ETAG is a small (less than 100 grams) onboard tracking and data unit combining GPS positioning, radio transmission (VHF / Iridium). It can perform automated and/or triggered activation of experiments and/or balloon termination devices, as well as basic data logging. Designed for payloads weighing less than 4 kg.

ETAG comes in a basic variant that includes a GPS, a downlink with position data and a few status updates. More advanced variants with programmable activation/deactivation criteria for both experiments and termination, as well as a variant including remote manual control of activation/deactivation of both experiments and manual termination using the Iridium satellite network.

The purposes of ETAG are to:



- track the balloon and payload in real time,
- transmit position (and telemetry) to the ground,
- support recovery after flight,
- activate/deactivate experiment based on when a predefined GPS coordinate, ascent/descent, speed or altitude threshold is reached, or satellite command is given,
- perform controlled termination of small balloon flights based on when a predefined GPS coordinate, ascent/descent speed or altitude threshold is reached, or satellite command is given.

The ETAG is provided by SSC Space.



Figure 7 - ETAG

3.1.4 EXPLORA experiment

The **EXPLORA experiment** is the core of the flight train, fully developed by each EXPLORA team. Chapter 5 describes the requirements and recommendations applicable to the experiment.

The EXPLORA experiment is the responsibility of the EXPLORA team.

3.1.5 PTU

The PTU sonde is a meteorological radiosonde providing in-flight measurements of **P**ressure, **T**emperature, and **hU**midity, as well as positional data, enabling monitoring of atmospheric conditions, supporting flight tracking, and scientific data collection.

The PTU is provided by SSC Space.



Figure 8 - PTU (e.g. Vaisala)

3.2 EXPLORA flight sequence

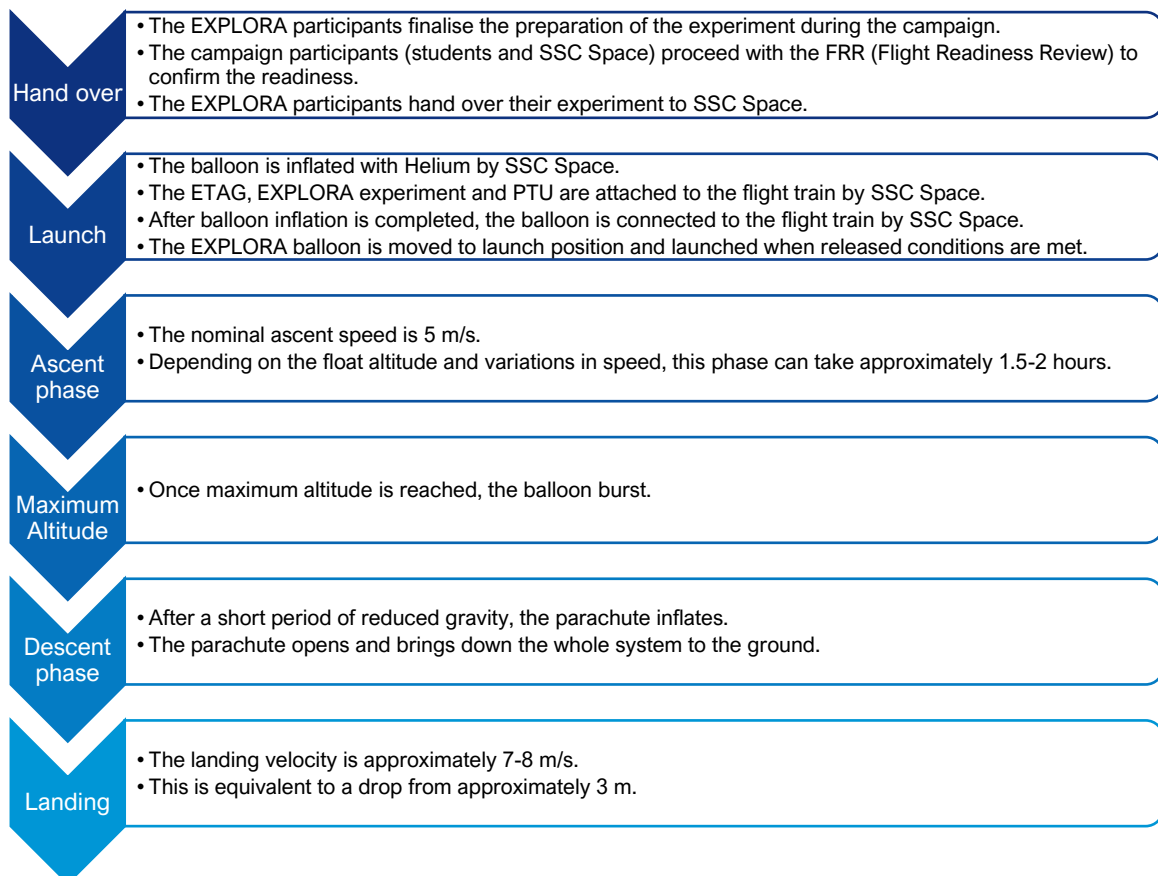


Figure 9 - EXPLORA flight sequence



3.3 EXPLORA flight trajectory

Flights	Launch day	Launch time	Total mass
EXPLORA Pilot	27.05.2024	10:07 LT	2.73 kg

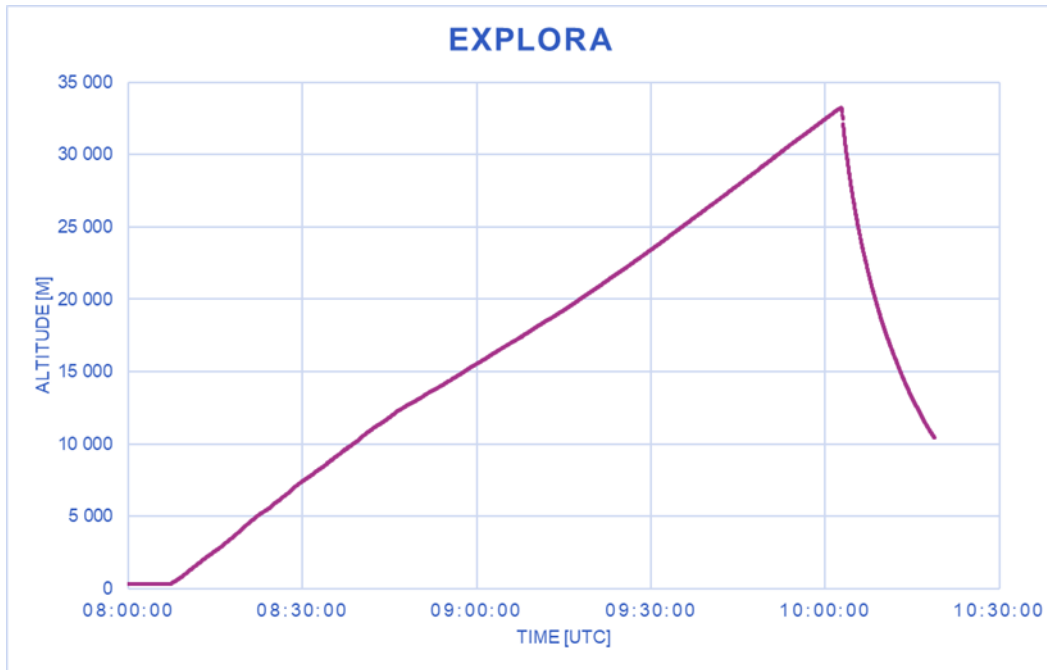


Figure 10 - Altitude vs Flight Time [EXPLORA Pilot (2024)]



Figure 11 - Estimated flight trajectories during EXPLORA launch window (20th of May 2024)



3.4 EXPLORA recovery

Nominally, the recovery is carried out by a helicopter and coordinated by SSC Space Recovery Officer who is taking care of the recovery operations. The EXPLORA balloon is then transported back to Esrange.

Recovery on the launch day strongly depends on weather conditions. If the weather conditions do not allow a safe recovery on launch day, the recovery will occur after the campaign. The EXPLORA experiment will therefore be shipped back to EXPLORA participants after the campaign.

NOTE: The EXPLORA participants shall prepare a storage box to use as shipping box in case of post campaign recovery.

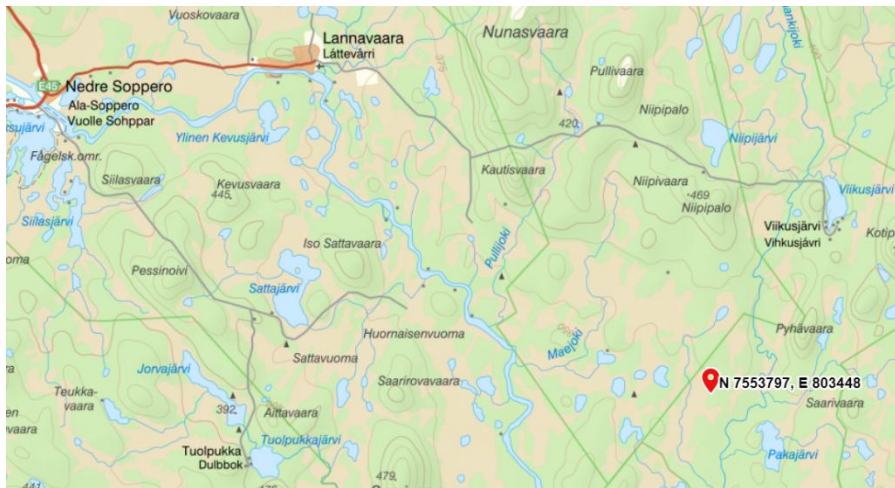


Figure 12 - Landing point [EXPLORA Pilot (2024)]



Figure 13 - Landing site [EXPLORA Pilot (2024)]



4 EXPLORA ENVIRONMENT

4.1 Thermal environment

- **Pre-Launch Phase**

In normal conditions, the preparation of the payload is done at a room temperature of approximately $20 \pm 5^\circ\text{C}$.

After preparation, the payload is brought outdoors to the launch pad. The outdoor temperature at the launch pad in May is normally between -3°C and 11°C and the exposure time can be up to several minutes.

- **Flight phase**

The thermal environment of the flight may see external air temperatures down to -80°C .

Note that the temperature is normally lowest at the tropopause (10-20 km), and normally a little higher in the stratosphere (>20 km).

Temperatures in the EXPLORA experiment vary depending on the exact configuration, time of flight and flight duration.

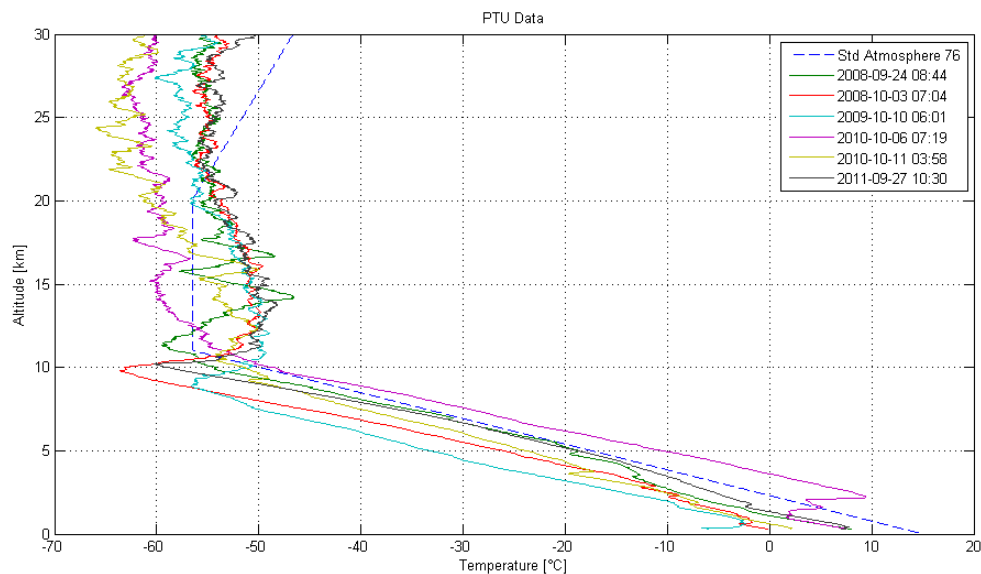


Figure 14 - PTU Sondes - Atmospheric temperatures graphs

- **Post-flight phase**

After the landing, the EXPLORA balloon might be subjected to rain and cold air in the impact area for a period of typically a few hours to several days if recovery on the same day is not possible.

The outdoor temperature in the impact area in May is normally between -3°C and 11°C .



4.2 Ambient pressure environment

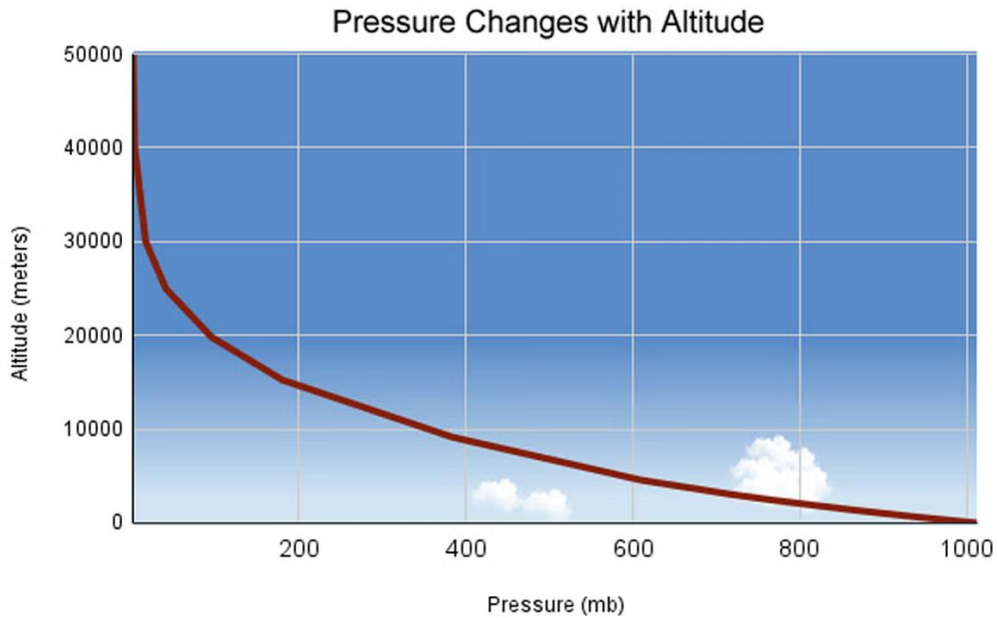


Figure 15 - Pressure vs Altitude

<https://scied.ucar.edu/learning-zone/atmosphere/change-atmosphere-altitude>



5 EXPLORA REQUIREMENTS

EXPLORA balloon complies with the rules of SERA regulations and ESM [1].

5.1 Mission definition

REQ #	REQUIREMENT
MIS-01	The EXPLORA experiment shall have an objective related to one of the following topics: <ul style="list-style-type: none"> • Science, • Technology, • Engineering, • Art, • Mathematics.
MIS-02	Each team shall deliver the EXPLORA experiment document to SSC Space, including the following information:
MIS-021	<ul style="list-style-type: none"> • a description of the experiment objectives and a justification of the physical parameters studied
MIS-022	<ul style="list-style-type: none"> • a justification of the sensors selection according to the experiment objectives
MIS-023	<ul style="list-style-type: none"> • a method to read and interpret the data collected and stored during the flight
MIS-03	Three versions shall be provided by the EXPLORA participants, each of which providing greater detail in comparison to the previous version: <ul style="list-style-type: none"> • v1.0 at Project Review 1 “Design” (<i>to be delivered 1 week before the review</i>), • v2.0 at Project Review 2 “Integration” (<i>to be delivered 1 week before the review</i>), • final version after the campaign to present the experiment results and lessons learnt (<i>to be delivered 1 week before the Results presentation</i>).

5.2 Mechanical design

REQ #	REQUIREMENT
MEC-01	The EXPLORA experiment shall have a mass below 1.8 kg.
MEC-02	The EXPLORA experiment shall have a maximum surface density of 13 g/cm ² .
MEC-03	The minimum dimensions of the EXPLORA experiment shall be 25 cm x 25 cm x 10 cm.
MEC-04	Any cables or booms sticking out of the EXPLORA experiment casing shall be able to be destroyed by a force of 230 N.
MEC-05	The inside of the EXPLORA experiment casing shall be accessible until hand over to SSC Space before launch (easy access to replace flight battery for example).
MEC-06	The EXPLORA experiment casing shall be connected to the EXPLORA flight train by means of a rope (e.g. braided cord), with a minimum load capacity of 20 kg.



	The hook to connect EXPLORA experiment and the flight train will be provided by SSC Space.
MEC-07	All sharp edges, both internal and external to the structure, shall be removed or suitably smoothed in a way that the structure can be safely handled by hand without risk of injury.
MEC-08	Mechanical drawings of the experiment structure with dimensions and mass shall be described in the EXPLORA experiment document.
MEC-09	It is recommended to use low density material like polystyrene, honeycomb cardboard or plastic materials.

Ejection systems are not allowed on EXPLORA.

5.3 Electrical design

REQ #	REQUIREMENT
ELE-01	Electrical schematics and cabling map shall be presented in the EXPLORA experiment document.
ELE-02	If there is no telemetry system on board, the EXPLORA team shall store data on-board.

5.4 Radio frequency requirements

REQ #	REQUIREMENT																				
RF-01	<p>For every transmitter or receiver that will be used at Esrange, information must be given to SSC Space at Project Review 1 "Design" to receive permission to transmit RF.</p> <p>It is necessary to apply for permission. SSC Space will apply on behalf of EXPLORA participants. The inputs required are transmitting frequency, radiated power, bandwidth of signal, antenna, antenna pattern, and modulation type.</p> <p>At Esrange, the reception of weak satellite signals might be jammed, and special care must therefore be taken regarding when and how RF transmitting occurs.</p> <p>The following frequencies are used in safety, telemetry, and recovery systems and are therefore not allowed for use by any experiment:</p> <table border="1"> <tbody> <tr> <td>400-405 MHz</td> <td>PTU radiosonde</td> </tr> <tr> <td>1025-1035 MHz</td> <td>Air Traffic Control</td> </tr> <tr> <td>1089-1091 MHz</td> <td>Air Traffic Control</td> </tr> <tr> <td>1616-1626 MHz</td> <td>Iridium/Globalstar</td> </tr> <tr> <td>2025-2120 MHz</td> <td>Satellite uplink</td> </tr> <tr> <td>2200-2300 MHz</td> <td>Satellite downlink</td> </tr> <tr> <td>7450-7900 MHz</td> <td>Satellite downlink</td> </tr> <tr> <td>8025-8500 MHz</td> <td>Satellite downlink</td> </tr> <tr> <td>10700-12750 MHz</td> <td>Satellite downlink</td> </tr> <tr> <td>25500-27000 MHz</td> <td>Satellite downlink</td> </tr> </tbody> </table>	400-405 MHz	PTU radiosonde	1025-1035 MHz	Air Traffic Control	1089-1091 MHz	Air Traffic Control	1616-1626 MHz	Iridium/Globalstar	2025-2120 MHz	Satellite uplink	2200-2300 MHz	Satellite downlink	7450-7900 MHz	Satellite downlink	8025-8500 MHz	Satellite downlink	10700-12750 MHz	Satellite downlink	25500-27000 MHz	Satellite downlink
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10700-12750 MHz	Satellite downlink																				
25500-27000 MHz	Satellite downlink																				



5.5 Safety requirements

The EXPLORA experiments must fulfil safety requirements according to SERA regulations, ESM but also [Swedish laws](#).

Any experiment that is deemed risky to the public, staff or participants, will not be flown. EXPLORA participants should perform any simulation, analysis and testing that will help to convince SSC Space that the experiment is safe to fly and handle. If there are any items that can be identified as safety risks, contact SSC Space.

REQ #	REQUIREMENT
SAF-01	Each EXPLORA team shall fill in and deliver the GSP-Q to SSC Space 1 week prior to the Project Review 2 "Integration".
SAF-02	Li-ion batteries are not allowed on-board EXPLORA (since they cannot be moved into a recovery helicopter).
SAF-03	Animals alive or dead are not allowed on board EXPLORA.
SAF-04	Pyrotechnics systems are not allowed on board EXPLORA.
SAF-05	Pressurized systems are not allowed on board EXPLORA.
SAF-06	Electrical systems with tension higher than 24V without protection must be encapsulated within a box labelled "DANGER – Tensions equal to xxx V".
SAF-07	<p>If the EXPLORA experiment has at least one on-board camera pointing or likely pointing towards land during the flight, the EXPLORA teams shall request the permission of photos/videos publication to the following authorities:</p> <ul style="list-style-type: none"> • Estrange Security The EXPLORA team shall request the Estrange photography application form to SSC Space to take photos/videos of Estrange Space Center. The application form shall be filled in and sent back to SSC Space 1 week before Project Review 2 "Integration". Photos/videos shall be approved by SSC Space before publication. • Lantmäteriet (Swedish land) The EXPLORA team shall request approval from the Swedish authority Lantmäteriet before publishing photos/videos of the Swedish land. The request shall be done after flight by uploading photos/videos on Lantmäteriet website. <p>No publication or storage on a Cloud is allowed until approval. The experiments shall notify SSC Space when approval is received.</p>

1 Explo- sives	2 Flamma- bles	3 Chemi- cals	4 Batteries	5 Biology	6 Trans- mitter RF	7 Pressure Vessel	8 Radio Active



9 Mechanics	10 Laser	11 Ground Support Equipment	12 Experiment on animals and GMO	13 High Voltage or High Current	14 Geomapping instruments and sensors	15 Other	16 Recovery	17 Late Access	18 NCR List

Figure 16 - Estrange risks table (GSP-Q)

5.6 Testing recommendations

The following section provides recommendations for the EXPLORA participants. Recommendations are not requirements and therefore not mandatory. Performing those tests shall be decided by the teacher(s).

Do not hesitate to contact SSC Space for further information and support (explora@sscspace.com).

Before planning any tests, it is important to remember that tests enable a better robustness of the experiment but request time.

Before designing any passive or active thermal control, a thermal analysis should be made, considering mostly conduction and solar radiation, but also other thermal exchanges, such as convection (at lower altitudes) and albedo (for any part of the experiment outside the gondola).

NOTE: active thermal control could be complex and is only recommended to advanced EXPLORA participants.

REQ #	RECOMMENDATION (tests are recommended but not mandatory)
TEST-01	<p>A vacuum test is recommended to verify that systems, mainly electrical, have nominal performance in the absence of convective cooling.</p> <p>Basic Procedure</p> <ul style="list-style-type: none"> The experiment shall be integrated and placed in a vacuum chamber (pressure below 5 mbar). Experiment data shall be supervised and recorded during the test. The experiment shall be operating during the lowering of the pressure in the vacuum chamber. The experiment shall be in a similar mode as during the flight. After this functional test / flight sequence has been performed, it is recommended that the experiment is kept operating for an additional 15 minutes, to detect any leakages or overheating problems.



TEST-02	<p>A thermal test is recommended to verify the thermal analysis and the design of the experiment.</p> <p>Basic Procedure</p> <ul style="list-style-type: none">• The experiment shall be integrated and placed in a thermal chamber or a freezer.• Experiment data shall be supervised and recorded during the test.• The temperature shall preferably be measured in several places in the experiment.• Low temperature test: Regulate the temperature in the thermal chamber or in the freezer, preferably down to – 80°C but at least to -40°C. When the measured temperatures in the experiment have stabilized, perform a functional test / flight sequence. Be aware of condensation problems if the test is performed in normal humidity.
TEST-03	<p>Mechanical tests are recommended to ensure performance of the experiment during flight.</p> <p>Basic Procedure 1 – Verifying the static loads The experiment should be placed on a solid surface with a clear area around the test area.</p> <ul style="list-style-type: none">• The experiment should then be loaded with between 10 and 30 times the experiment’s own weight (depending on the structural design) in a stable and secure manner.• The experiment does not need to be fully complete/integrated, as long as the main structure is available together with an estimated mass budget for the missing parts. It is therefore possible to perform this test early on. <p>Basic Procedure 2 – Verifying the vibration</p> <ul style="list-style-type: none">• The experiment should be mounted in the back of a car or in a trailer.• The experiment should be driven over a bumpy road or rough terrain for several minutes.• Afterwards, the experiment should be checked for full functionality by system tests, but a visual check is also important to see if any cabling or mechanisms have been affected.
TEST-04	<p>A bench test is recommended to be performed before transport to Esrange Space Center. The test should be carried out for a maximum duration mission (30 minutes wait before launch, 1-3 hours flight and possibly a waiting time before recovery). This test should be carried out as there are many issues which arise only after long duration of operation.</p> <p>The experiment should be supervised at all times in case of a failure.</p> <p>Basic Procedure</p>



- The experiment should be assembled as for flight in a safe area removed from interference (both environmental and human).
- Monitoring of temperature and voltages for critical electronic components should be set up where desired.
- The experiment should be run as for flight.
- Following simulated launch, the experiment should be run as desired for ascent and descent.

6 EXPLORA MILESTONES DESCRIPTION

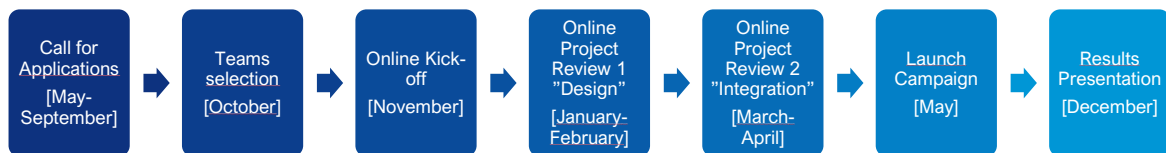


Figure 17 - EXPLORA programme milestones

6.1 Call for applications

Each interested team / high school in Sweden can apply to EXPLORA by filling in the EXPLORA proposal form [2] and send it to explora@sscspace.com.

The call for applications is open yearly from June to mid-October.

6.2 Teams selection

SSC Space will select EXPLORA teams based on the EXPLORA proposals received each year. SNSA will contribute to the selection if time allows.

The number of selected teams each year is based on SNSA funding from 2026 to 2029.



Figure 18 - Evolution of the # selected teams 2026-2029

6.3 Kick off

SSC Space is responsible for calling for an online kick-off meeting.

All selected teams will be invited.

Teacher(s) and students shall participate.

The kick-off is an introductory meeting presenting EXPLORA schedule, technical information, EXPLORA documentation and expectations for the next review.

6.4 Project Review 1 “Design”

SSC Space is responsible for organizing this online review for each selected team.

Teacher(s) and students shall participate.

Before the review

- The EXPLORA participants shall deliver the EXPLORA experiment document v1.0, 1 week before the review.

During the review

- The EXPLORA participants shall prepare a presentation showing the objectives of the experiment, the preliminary design (mechanical, electrical and software) of the experiment, the organization of the team and the outreach plan. This presentation shall last 15 minutes.
- The presentation will be followed by a technical discussion.

After the review



The students are responsible for writing the minutes of the meeting and including them in the EXPLORA experiment document.

6.5 Project Review 2 “Integration”

SSC Space is responsible for organizing this online review for each selected team.

Teacher(s) and students shall participate.

Before the review

- The EXPLORA participants shall deliver the EXPLORA experiment document v2.0 and GSP-Q, 1 week before the review.

During the review

- The EXPLORA participants shall prepare a presentation showing the status of the experiment (components delivery, manufacturing, assembly and integration), mass budget status, dimensions, team organization updates, outreach status. This presentation shall last 20 minutes.
- The presentation will be followed by a technical discussion (including Ground safety discussion based on GSP-Q).
- SSC Space will present information regarding the launch campaign:
 - Erange facilities,
 - balloon flight system,
 - launch operations,
 - campaign schedule.

After the review

- The students are responsible for writing the minutes of the meeting and including them in the EXPLORA experiment document.

6.6 Launch campaign

6.6.1 Preparation

The EXPLORA participants are strongly advised to think through all aspects of the experiment: the launch preparation, the flight phase, the recovery instructions (if any) and the post-flight tasks (ex: hardware inspection, experiment dismounting, preliminary data analysis).

With this input, make a detailed plan of all tasks to be done during the campaign. For each task:

- Assign team member(s),
- Estimate task duration,
- Identify needed tools.



A checklist is the key item to success: even the smallest thing, such as flipping a switch, should be on the list. A good checklist includes a verification method such as checking torque (and writing it down) or taking a photo.

Without good build-up plans and checklists there is a significant risk of failures and delays during the campaign week. All of this should be documented in the EXPLORA experiment document.

6.6.2 Facilities & Tools



Figure 19 - From left to right: the Dome, the Chapel, Cathedral and Basilica preparation & assembly buildings

Please note that Esrange is situated in a remote location. Therefore, acquiring any equipment could be difficult once arrived at the site.

If you need some special tools or equipment, be sure to either bring it with you, or specifically state that you need it in the EXPLORA experiment document.

6.6.3 Flight Readiness Review

The Flight Readiness Review is conducted by SSC Space when the EXPLORA experiment and the SSC Space systems are ready for flight.

The purpose of the FRR is to authorize the start of the launch procedure. It is a formal hand over of the experiment from the EXPLORA team to SSC Space.

Purpose of the review is:

- To ensure that the EXPLORA experiment is ready for the flight. For this, each appointed team leader shall give a status report.
- To inform all relevant personnel of the safety regulations applicable during the countdown phase.
- To inform all relevant personnel of general arrangements implied during the countdown phase.



6.6.4 Balloon launch conditions

Wind, flight trajectory, and visibility are important variables taken into consideration before starting the launch phase. This is under the responsibility of SSC Space.

NOTE: It is not possible to guarantee that a launch can take place during the campaign period. Plan and prepare so that it is possible for someone else to operate and document the functions of your experiment if the launch is postponed to a later opportunity.

6.6.5 Safety on the balloon pad

SSC Space has the overall responsibility for safety and has the Veto right in all safety issues during all activities within the Erange base area.

Erange provides participants with high visibility safety vests. Most likely the participants will see the launch from one of the balloon integration buildings.

6.6.6 Personnel during the launch

SSC Space staff	Role description
Programme Manager	The programme manager has several roles in the EXPLORA programme. They act as payload managers and is the main point of contact for the EXPLORA participants, reviews the EXPLORA experiment report and prepares the Campaign Requirements Plan. They act as campaign managers, responsible for the services to be delivered by SSC Space for SNSA and EXPLORA participants. They act as Flight Director, the focal point for all launch activities.
Launch Officer	They handle all personnel and equipment related to the launch. The Launch Officer is also responsible for safety on the launch pad.
Flight Safety Officer	They are responsible for the Flight Safety Plan establishing predicted trajectories and meteorology briefing to allow the flight.
Electronic Supervisor	They are responsible for preparing, operating and maintaining the ETAG and PTU.

6.6.7 Countdown and launch

During the countdown phase, important countdown information is displayed on 'black screens' at various locations around the launch site.

The decision to start the launch operations is taken at a weather briefing. This decision is based on dedicated weather forecasts, as well as wind data possibly obtained by a meteorological balloon released from Erange. If the weather conditions are unsuitable for launching the balloon, the launch will be delayed until the flight conditions are fulfilled.



The general launch procedure may be subject to changes.

Check box	Action	Responsible person
<input type="checkbox"/>	Meteorological conditions check	Flight Safety Officer
<input type="checkbox"/>	Flight Readiness Review	Programme Manager
<input type="checkbox"/>	EXPLORA experiment hand over to SSC Space	EXPLORA team
<input type="checkbox"/>	Weight calculations check	Launch Officer
<input type="checkbox"/>	Balloon ready for inflation	Launch Officer
<input type="checkbox"/>	Flight clearance check	Flight Safety Officer
<input type="checkbox"/>	Start of inflation	Launch Officer
<input type="checkbox"/>	Inflation completed	Launch Officer
<input type="checkbox"/>	Moving from integration hall to balloon pad	Launch Team
<input type="checkbox"/>	Check EXPLORA team is inside the integration hall	Programme manager
<input type="checkbox"/>	Check safety pad clear	Launch Officer
<input type="checkbox"/>	Authorize launch	Launch Officer
<input type="checkbox"/>	Balloon release	Launch Officer

6.7 Results presentation

Finally, SSC Space is responsible for organizing an online results presentation.

All the EXPLORA teams shall prepare a 15-minute presentation reminding the experiment objectives, describing the experiment, and presenting the results and lessons learnt.

All EXPLORA teams will be invited to this online presentation.



7 REQUIREMENTS & VERIFICATION

REQ #	REQUIREMENT	CHECK
MIS-01	The EXPLORA experiment shall have an objective related to one of the following topics: Science, Technology, Engineering, Art, Mathematics.	<input type="checkbox"/>
MIS-02	Each team shall deliver EXPLORA experiment document to SSC Space, including the following information:	<input type="checkbox"/>
MIS-021	<ul style="list-style-type: none"> a description of the experiment objectives and a justification of the physical parameters studied 	<input type="checkbox"/>
MIS-022	<ul style="list-style-type: none"> a justification of the sensors selection according to the experiment objectives 	<input type="checkbox"/>
MIS-023	<ul style="list-style-type: none"> a method to read and interpret the data collected and stored during the flight 	<input type="checkbox"/>
MIS-03	Three versions shall be provided by the EXPLORA participants, each of which providing greater detail in comparison to the previous version:	-
	<ul style="list-style-type: none"> v1.0 at Project Review 1 “Design” (<i>to be delivered 1 week before the review</i>), 	<input type="checkbox"/>
	<ul style="list-style-type: none"> v2.0 at Project Review 2 “Integration” (<i>to be delivered 1 week before the review</i>), 	<input type="checkbox"/>
	<ul style="list-style-type: none"> final version after the campaign to present the experiment results and lessons learnt (<i>to be delivered 1 week before the Results presentation</i>). 	<input type="checkbox"/>

REQ #	REQUIREMENT	CHECK
MEC-01	The EXPLORA experiment shall have a mass below 1.8 kg.	<input type="checkbox"/>
MEC-02	The EXPLORA experiment shall have a maximum surface density of 13 g/cm ² .	<input type="checkbox"/>
MEC-03	The minimum dimensions of the EXPLORA experiment shall be 25 cm x 25 cm x 10 cm.	<input type="checkbox"/>
MEC-04	Any cables or ropes sticking out of the EXPLORA experiment casing shall be able to be destroyed by a force of 230 N.	<input type="checkbox"/>
MEC-05	The inside of the EXPLORA experiment casing shall be accessible until hand over to SSC Space before launch (easy access to replace flight battery for example).	<input type="checkbox"/>
MEC-06	The EXPLORA experiment casing shall be connected to the EXPLORA flight train by means of a rope (e.g. braided cord), with a minimum load capacity of 20 kg.	<input type="checkbox"/>
	The hook between the EXPLORA experiment and the flight train will be provided by SSC Space.	
MEC-07	All sharp edges, both internal and external to the structure, shall be removed or suitably smoothed such that the structure can be safely handled by hand without risk of injury.	<input type="checkbox"/>
MEC-08	Mechanical drawings of the experiment structure with dimensions and mass shall be described in the EXPLORA experiment document.	<input type="checkbox"/>
MEC-09	It is recommended to use low density material like polystyrene, honeycomb cardboard or plastic materials.	<input type="checkbox"/>



REQ #	REQUIREMENT	CHECK
ELE-01	Electrical schematics and cabling map shall be presented in the EXPLORA experiment document.	<input type="checkbox"/>
ELE-02	If there is no telemetry system on board, the EXPLORA team store on-board data.	<input type="checkbox"/>

REQ #	REQUIREMENT	CHECK
RF-01	It is necessary to apply for permission . SSC Space will apply on behalf of EXPLORA participants. The inputs required are: transmitting frequency, radiated power, bandwidth of signal, antenna, antenna pattern, and modulation type. At Esrange, the reception of weak satellite signals might be jammed, and special care must therefore be taken regarding when and how RF transmitting occurs. Check that the experiment is not using unauthorized frequencies.	<input type="checkbox"/>

REQ #	REQUIREMENT	CHECK	
SAF-01	Each EXPLORA team shall fill in and deliver the GSP-Q to SSC Space 1 week prior to the Project Review 2 "Integration".	<input type="checkbox"/>	
SAF-02	Li-ion batteries are not allowed on-board EXPLORA (since they cannot be moved into a recovery helicopter).	<input type="checkbox"/>	
SAF-03	Animals alive or dead are not allowed on board EXPLORA.	<input type="checkbox"/>	
SAF-04	Pyrotechnics systems are not allowed on board EXPLORA.	<input type="checkbox"/>	
SAF-05	Pressurized systems are not allowed on board EXPLORA.	<input type="checkbox"/>	
SAF-06	Electrical systems with tension higher than 24V without protection must be encapsulated within a box labelled "DANGER – Tensions equal to xxx V".	<input type="checkbox"/>	
SAF-07	If the EXPLORA experiment has at least one on-board camera pointing or likely pointing towards land during the flight, the EXPLORA teams shall request the permission of photos/videos publication to the following authorities:	-	
		<ul style="list-style-type: none"> • Esrange Security 	<input type="checkbox"/>
		<ul style="list-style-type: none"> • Lantmäteriet (Swedish land) 	<input type="checkbox"/>

REQ #	RECOMMENDATION (tests are recommended but not mandatory)	CHECK
TEST-01	Vacuum test	<input type="checkbox"/>
TEST-02	Thermal test (low temperature)	<input type="checkbox"/>
TEST-03	Mechanical test	<input type="checkbox"/>
TEST-04	Bench test	<input type="checkbox"/>

Congratulations, your experiment is compliant with the EXPLORA requirements.

Welcome to the launch campaign!