

CANSAT IRELAND COMPETITION 2018



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1 INTRODUCTION

The European Space Agency (ESA) endorses and supports a range of education activities across its Member States. The CanSat project, aimed at secondary school students, gives students opportunities to learn skills in electronics, sensors, programming/coding, radio telemetry, mechanical design, parachute design, problem solving, teamwork, and communications & outreach.

ESERO Ireland (www.esero.ie) has managed the CanSat Ireland competition since 2013 and in conjunction with Blackrock Castle Observatory (www.bco.ie) will run the competition again for 2018.

At the CanSat Ireland regional and national finals each CanSat team has their CanSat launched by quad/octo-copters and by rocket at the national final. After launch, the CanSat must take measurements and send data to the ground station (laptop) as it descends. After analysing the data, the team then makes a 10 minute presentation to a panel of judges.

The winner of the CanSat Ireland National Competition goes on to represent Ireland in the European CanSat Competition in June 2018.

1.1 What is a CanSat?

A CanSat is a simulation of a real satellite, integrated within the volume and shape of a soft drink can. The challenge for the students is to fit all the major subsystems found in a satellite, such as power, sensors and a communication system, into this minimal volume. The CanSat is then launched to an altitude of about 400 metres by a rocket, dropped from a platform or captive balloon and its mission begins: to carry out a scientific experiment, achieve a safe landing and analyse the data collected.



Confey College CanSat Team – winners of the 2106 CanSat Ireland National Competition



1.2 Educational value of the CanSat experience

The CanSat experience provides the participating student teams the opportunity to go through all the phases typical of a real space project, from selecting the mission objectives, designing the CanSat, integrating the components, testing the system, preparing for launch and then analysing the scientific data obtained. Through this process the students:

- learn by doing,
- get acquainted with the inquiry-based methodology typical of real-life scientific and technical work,
- acquire and/or reinforce senior cycle curricular concepts in STEM subjects.
- understand the importance of coordination and teamwork,
- enhance their communication skills.

2 COMPETITION OVERVIEW

2.1 CanSat Ireland Competition Phases

The 2018 CanSat Ireland Competition will consist of 5 phases:

- Phase 1 – Launch of the CanSat Ireland Competition
- Phase 2 – CanSat Ireland Regional Teachers & Mentors workshops & student classes
- Phase 3 – CanSat Ireland Regional Competitions (March 2018)
- Phase 4 – Winners of the CanSat Ireland Regional competitions prepare for the CanSat Ireland National
- Phase 5 – CanSat Ireland National Final (April 26/27th 2018)

The winners of the CanSat Ireland competition go on to represent Ireland at the European CanSat competition in June 2018.

2.2 CanSat Ireland Regional Partners

The CanSat Ireland competition is run in partnership with 7 Institutes of Technology:

Athlone Institute of Technology (AIT)

Cork Institute of Technology (CIT)

Dublin Institute of Technology (DIT)

Galway-Mayo Institute of Technology (GMIT)

Limerick Institute of Technology (LIT)

Sligo Institute of Technology (IT Sligo)

The Institute of Technology Tralee (IT Tralee)



Each institute launches their CanSat Ireland Regional Competition starting off with a Teachers & Mentors workshop in Nov/Dec 2017.

Team Eligibility conditions

In order for a team to enter the regional/national finals the following conditions must be fulfilled:

- CanSat teams should comprise a **minimum** of **4** and a **maximum** of **6** (TY/Senior cycle) full-time enrolled secondary school students assisted by a teacher. Teams of 4/5 students are advisable to maximise the learning process.
- Team members can only be part of **1** team per year.
- CanSat teams may substitute a maximum of one person on the team if necessary as long as the new member has not been part of another CanSat team in the same year. The total number of the team must not exceed 6 including the substitute.
- At least 50% of the team members must hold the nationality of an ESA Member State¹ or an ESA Associate State.
- One teacher can be responsible for one team per year only.
- The National Final winning team must be able to attend the European Finals in June/July 2018
- Any National Final winning team or team member cannot enter the competition more than once.
- Each team must complete the registration form prior to the regional final to ensure compliance and be granted permission to enter the final.

2.3 CanSat Ireland Regional Competitions

Staff members from the partnering Institutes of Technologies, and from local companies are assigned to CanSat teams/school as mentors for the competition.

Between October 2017 and March 2018, under the supervision of the regional partners, the student teams carry out technical work on their CanSats and engage in outreach activities.

The CanSat teams have to perform the following tasks:

- Selection of mission objectives;
- Definition of technical requirements necessary to achieve the objectives;
- Design of CanSat hardware and software;
- Documented design reviews, leading to design refinement;
- Integration and testing of the CanSat;
- Regional launch campaign: Technical & Outreach work.

¹ **ESA Member States in 2017 (22):**

Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, United Kingdom.

ESA Associate States in 2016: Canada, Slovenia



The regional CanSat competition finals are scheduled to take place on:

March 14 th	Limerick Institute of Technology & The Institute of Technology Tralee
March 10 th	Cork Institute of Technology
March 20 th	Athlone Institute of Technology
March 15 th	Dublin Institute of Technology
March 22 nd	Galway/Mayo Institute of Technology
March 13 th	Sligo Institute of Technology

For CanSat Ireland Regional Competitions, CanSat teams should first focus on the Primary Mission which is mandatory. Teams which focus on secondary missions before mastering primary missions at regional competitions will be at a disadvantage. Teams should allocate work between team members. At the CanSat Ireland regional competitions each CanSat will be launched by quad/octocopter. CanSat teams are expected to receive live data at the ground station. After analysing their data, the CanSat teams make a 10 mins. presentation to a judging panel. A further 10 minutes per team will be allocated for Q & A. Teams will be expected to present and explain **labelled** graphs of the data received from launch.

Qualification to National final

If there are 7 or more teams participating in the CanSat Ireland regional competition (i.e teams that launch CanSats and make a presentation to the judging panel) then two teams from that region will qualify for the CanSat Ireland National final. For regions with 6 or less teams competing in the regional final 1 team will qualify for the national final.

2.4 CanSat Ireland National Final

The CanSat Ireland National Final will take place on April 26 and 27th 2018 at Emo Court Portlaoise (launches in the afternoon of 26 April) and Killeshin Hotel, Portlaoise (presentations on 27th April).

Between March and April 2018, (i.e. after regional competitions and prior to national final) under the supervision of the mentors, the qualifying teams will carry out technical work on their CanSats applying the procedures used in the typical lifecycle of a real space project, which are:

- Selection of mission objectives;
- Definition of technical requirements necessary to achieve these objectives;
- Design of hardware and software;
- Design of ground station/ground telecommunication system;
- Documented Design Reviews, leading to design refinement;
- Integration and testing of the CanSat.

At the CanSat Ireland National Final each CanSat will be launched by quadcopter and rocket. Similar to the regional competitions, each team must analyse their launch data and make a 10 minutes presentation with appropriate **labelled** graphs to a judging panel. A further 15 minutes will be allocated per team for Q & A.



The judges will be evaluating the CanSat teams based on their preparedness for the European CanSat competition as well as all their technical, educational, teamwork and outreach work. Teams competing in the CanSat Ireland National Final will be asked to submit a Critical Design Review (CRD) Report in advance of the national final and a Pre-launch Report in advance of the European competition.

What is the Critical Design Review (CDR) report?

The CDR report is a technical document that ensures that the design can meet the stated performance requirements, taking into account all the system constraints. Compiling the CDR report allows student teams to evaluate the detailed design effort, determine readiness for hardware fabrication and for software coding, and establish the final configuration of the secondary mission.

The CanSat CDR report must contain:

- A demonstration that all the requirements stated in the guidelines of European CanSat Competition have been fulfilled.
- Selection of Mission Objectives
- Definition of technical requirements necessary to achieve these objectives
- The design specifications needed to fulfil the secondary mission
- Results of the requirements verification tests completed
- Summary of all work done to date (progress report)
- Description of CanSat mission, system and functionalities.
- Detailed budget.
- Outline of project schedule.

The CDR report must be submitted to alan.giltinan@bco.ie no later than 5pm on the 20th April 2018, with the name of the team and of the document submitted clearly written in the subject line (e.g. "Team A_ CanSAT CDR report"). The document should be attached in a pdf format with the following file name format: *teamA_ cansat CDR report.pdf*.

A printed copy should be provided to the organisers by 2pm on Thursday 26th April 2018.

The CanSat Ireland national winning team will get feedback on this CDR which will form the basis of the Pre-Launch Report which must be submitted to ESA by 10 June 2018 for the European CanSat Competition.

Submission of a Pre-launch Report of a maximum of 30 pages to ESA by 10 June 2018, 22:00 CET, summarising all the work done (progress report), providing a full description of the CanSat mission, system and functionalities, and indicating the steps, rationale and trouble-shooting which was needed to get to the CanSat refined design, as well as a detailed budget. This document should accurately record all the details of the completed CanSat prototype. This will be the main document provided to the Jury members during the launch campaign, who will then be tasked to evaluate the work and performance of each team.

The Pre-Launch Report must be submitted to ESA at cansat@esa.int with the name of the team and of the document submitted written in the subject line (e.g. "Team A Pre-launch report"). The



document attached should be in a pdf format, with the following file name format: teamA_prelaunch report.pdf.

After the European CanSat competition, CanSat teams are expected to produce the **CanSat Final Report** (CFR) summarising the work before, during and after the competition with a special focus on obtained results and (scientific/engineering) conclusions. Only after submission of the CFR will the members of the teams received and ESA certificate recognising their participation in the 2018 European CanSat competition.

Further information about preparation for the European CanSat final in June is available in the document '[2018 EUROPEAN CANSAT COMPETITION GUIDELINES](#)'.

Overview of competition Timeline:

CanSat Ireland competition dates	
Activity	Date
Launch of CanSat Ireland	October 2017
Contact Schools about participation	13 th November 2017
Kits send to schools	20 November 2017
Regional finals	March/April 2018
Critical Design Review report submission	20 th April 2018
National Finals	April 26/27 th 2018



3 MISSION OVERVIEW

The CanSat competition is designed to simulate all aspects of a real space mission, including design, development, testing, launch, operations and data analysis.

3.1 The rocket launch

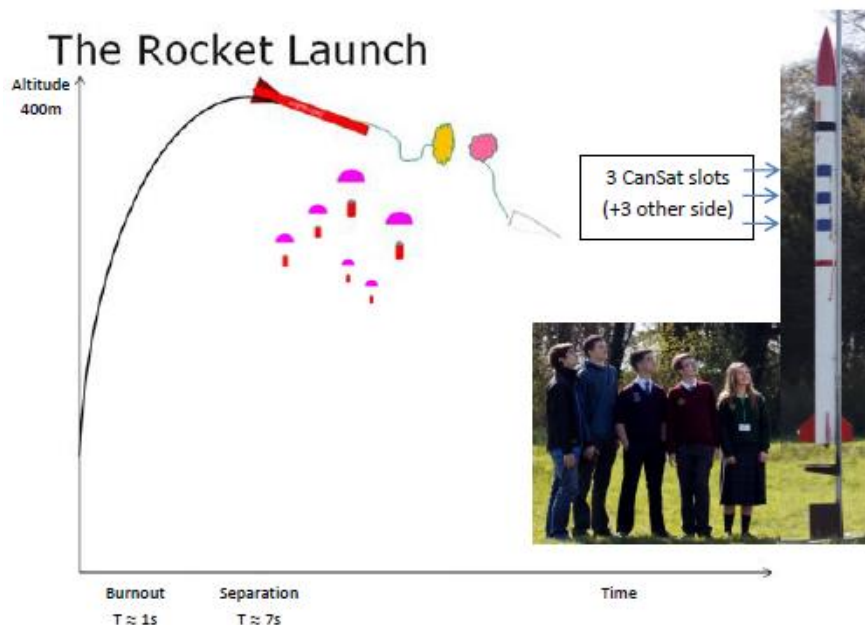
A model rocket will launch the CanSats at the National Final in Birr. Cansat design should adhere to the dimensions below.

The rocket can hold 6 CanSats on board and has the following characteristics:

Mass:	3 kg
Length:	2.5 m
Diameter:	250 mm
Apogee:	approx. 400 m
Flight time:	approx. 60 s

The rocket would deploy its parachute at apogee, which is reached at around 6 seconds after take-off. Just after the apogee (0-2 seconds later) the CanSats separate from the rocket and will descend on separate parachutes. The CanSats are usually found within a few hundred metres of the launch site, however recovery of the CanSats cannot be guaranteed.

During the flight, the rocket can reach a maximum acceleration of 20g (i.e. approx. 20 m/s² in the vertical direction and a maximum velocity of 550 km/h.



3.2 Primary and Secondary CanSat missions

Primary mission

The team must build a CanSat and program it to accomplish the compulsory Primary Mission, as follows:

After release and during descent, the CanSat must measure the following parameters and transmit the data as telemetry at least once every second to the ground station:

- Air temperature
- Air pressure

It must be possible for the team to analyse the data obtained (for example, make a calculation of altitude) and display it in appropriately **labelled** graphs (for example, altitude vs. time and temperature vs. altitude). This analysis can be done in a- post flight analysis.

Secondary mission

The secondary mission for the CanSat must be selected by the team. It can be based on other satellite missions, a perceived need for scientific data for a specific project, a technology demonstration for a student-designed component, or any other mission that would fit the CanSat's capabilities.

Some examples of missions are listed below, but teams are free to design a mission of their choice, as long as it can be demonstrated to have some scientific, technological or innovative value. Teams should also keep in mind the limitations of the CanSat mission profile, and focus on the feasibility (both technical and administrative) of their chosen mission.

Some secondary mission examples:

1. Advanced telemetry

After release and during descent, the CanSat measures and transmits additional telemetry to that required for the primary mission, for example:

- Acceleration
- GPS location
- Radiation levels

2. Telecommand

During descent, commands are sent from the ground to the CanSat to perform an action, such as switching a sensor on and off, changing the frequency of measurements, etc.



3. Targeted landing

The CanSat navigates autonomously with a control mechanism such as a parafoil. The objective is for the CanSat to land as close as possible to a fixed target point on the ground after it has been released from the rocket. This mission is an advanced telemetry/telecommand mission - navigation data is exchanged between the CanSat and a ground station throughout the descent.

4. Landing system

For this mission, an alternative safe landing system for the CanSat would be deployed, such as a bespoke parachute or airbag.

5. Planetary probe

A CanSat can simulate an exploration flight to a new planet, taking measurements on the ground after landing. Teams should define their exploration mission and identify the parameters necessary to accomplish it (e.g. pressure, temperature, samples of the terrain, humidity, etc.).



CanSats recovered during the 2015 European CanSat Competition Launch Campaign

3.3 CanSat requirements

The CanSat hardware and missions must be designed to the following requirements and constraints:

- [1] All the components of the CanSat must fit inside a standard soda can (115 mm height and 66 mm diameter), with the exception of the parachute. An exemption can be made for radio antennas and GPS antennas, which can be mounted externally (on the top or bottom of the can, not on the sides), based on the design.
N.B. The rocket payload area has 4.5 cm of space available per CanSat, along the can's axial dimension (i.e. height), which must accommodate all external elements including: parachute, parachute attachment hardware, and any antennas.
- [2] The antennas, transducers and other elements of the CanSat cannot extend beyond the can's diameter until it has left the launch vehicle.
- [3] The mass of the CanSat must be between 300 grams and 350 grams. CanSats that are lighter must have additional ballast fitted to reach the 300 grams minimum mass limit required.
- [4] Explosives, detonators, pyrotechnics, and flammable or dangerous materials are strictly forbidden. All materials used must be safe for the personnel, the equipment and the environment. Material Safety Data Sheets (MSDS) will be requested in case of doubt.
- [5] The CanSat must be powered by a battery and/or solar panels. It must be possible for the systems to be switched on for four continuous hours.
- [6] The battery must be easily accessible in case it has to be replaced/recharged.
- [7] The CanSat must have an easily accessible master power switch.
- [8] Inclusion of a retrieval system (beeper, radio beacon, GPS, etc.) is recommended.
- [9] The CanSat should have a recovery system, such as a parachute, capable of being reused after launch. It is recommended to use bright coloured fabric, which will facilitate recovery of the CanSat after landing.
- [10] The parachute connection must be able to withstand up to 1000 N of force. The strength of the parachute must be tested, to give confidence that the system will operate nominally.
- [11] For recovery reasons, a maximum flight time of 120 seconds is recommended. If attempting a directed landing then a maximum of 170 seconds flight time is recommended.
- [12] A descent rate between 8 m/s and 11 m/s is recommended for recovery reasons. In case of attempting a directed landing, a lower descent rate of 6m/s is recommended.
- [13] The CanSat must be able to withstand an acceleration of up to 20 g.
- [14] The total budget of the final CanSat model should not exceed 500€. Ground Stations (GS) and any related non-flying item will not be considered in the budget. More information regarding the penalties in case of exceeding the stated budget can be found in the next section.
- [15] In case of sponsorship, all the items obtained should be specified in the budget with the corresponding costs on the market at that moment.
- [16] The CanSat must be flight-ready upon arrival to the launch campaign. A final technical inspection of the CanSats will be done by authorised personnel before launch.



4 EVALUATION AND SCORING

For CanSat Ireland regional and national Irish competitions, CanSat teams will be evaluated using similar criteria used during the European CanSat competition.

Educational value

For this item, the judging panel will consider the quality of the Critical Design Report and the team presentations, the level of effort made by the team and how much the team appears to have learned throughout the project.

Technical achievement

Innovative aspects of the project will be judged, for example: the mission selected and the hardware/software used. It will be also taken into account how the teams obtained results, how reliable and robust the CanSat was and how the CanSat performed. If the CanSat did not succeed in accomplishing the missions but the team is able to explain the reasons why and suggest improvements, it will be also taken into account positively.

Team work

The judging panel will assess how well the team worked together on the assignment, the distribution of tasks, the planning and execution of the project and the team's success in obtaining the necessary funding, support and advice.

Outreach

The team will be scored on how well the project was communicated to the school and the local community, taking into account any webpages, blogs, presentations, promotional materials, media coverage, etc.

Marking scheme

The overall balance between the above items to be evaluated is as shown in the table.

1. Educational value	20%
2. Technical achievement	50%
3. Team work	15%
4. Outreach	15%
TOTAL	100%



5 FUNDING

For the CanSat Ireland National Final 2018, accommodation and food costs will be covered for a maximum of six students and one teacher per participating team.

Teams are responsible for obtaining alternative sponsorship for any additional CanSat hardware (beyond the kit supplied), as well as the team's travel expenses to and from the CanSat Ireland National Final which will be held in Emo Court (launches) and Killeshing Hotel, Portlaoise (presentations)

6 CONTACT

All questions and expressions of interest should be directed to one of the following:

<p>Stephanie O'Neill, ESERO Ireland Manager;</p> <p>Science Foundation Ireland, Wilton Park House, Wilton Place, Dublin 2.</p> <p>Email: stephanie.oneill@sfi.ie Phone: 01 607 3014</p>	<p>Alan Giltinan, Project Manager for CanSat 2018</p> <p>Blackrock Castle Observatory Blackrock, Cork, Ireland.</p> <p>Email: alan.giltinan@bco.ie Phone: 021 432 6125</p>
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More information

ESERO Ireland <http://esero.ie/>

ESA Education CanSats Portal <http://www.esa.int/Education/CanSat>

