

# CANSAT IRELAND COMPETITION 2019



# Table of Contents

<b>1</b>	<b>INTRODUCTION.....</b>	<b>3</b>
	What is a CanSat? .....	3
	Educational value of the CanSat experience .....	4
<b>2</b>	<b>COMPETITION OVERVIEW .....</b>	<b>4</b>
	CanSat Ireland Competition Phases .....	4
	CanSat Ireland Regional Partners .....	4
	CanSat Ireland Regional Competitions .....	5
	CanSat Ireland National Final .....	6
<b>3</b>	<b>MISSION OVERVIEW.....</b>	<b>9</b>
	The rocket launch .....	9
	Primary and Secondary CanSat Ireland missions .....	10
	Primary mission .....	10
	Secondary mission .....	10
	CanSat requirements .....	12
<b>4</b>	<b>EVALUATION AND SCORING .....</b>	<b>13</b>
	Technical achievement .....	13
	Scientific Value .....	13
	Professional Competencies .....	14
	Outreach .....	14
	Marking scheme .....	14
<b>5</b>	<b>FUNDING .....</b>	<b>15</b>
<b>6</b>	<b>CONTACT .....</b>	<b>15</b>
	More information .....	15



## 1 INTRODUCTION

The European Space Agency (ESA) endorses and supports a range of CanSat activities across its Member States, all leading to a European final event – the European CanSat competition. The CanSat project, aimed at secondary school students, mainly addresses Technology, Physics, and programming curricular subjects. By offering the practical experience of working on a small-scale space project, CanSat makes use of these subjects in an interdisciplinary manner and promotes collaboration and teamwork.

ESERO Ireland ([www.esero.ie](http://www.esero.ie)) has managed the CanSat Ireland competition since 2012 and in conjunction with CIT Blackrock Castle Observatory ([www.bco.ie](http://www.bco.ie)) will run the competition again for 2019.

At the CanSat Ireland regional finals each CanSat Ireland 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 2019.

### What is a CanSat?

A CanSat is a simulation of a real satellite, integrated within the volume and shape of a soft drinks 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 by a rocket to an altitude of about 400 metres, or dropped from a platform, drone, or captive balloon. Then its mission begins. This involves carrying out a scientific experiment, achieving a safe landing, and analysing the data collected.



*Marist College CanSat Team, Irish winners of the 2018 CanSat European Competition with Matt Taylor of ESA*

## **Educational value of the CanSat experience**

Through the CanSat Ireland project, the participating student teams experience all the phases of a real space project, from selecting the mission objectives, designing their CanSat, integrating the components, testing the system, preparing for launch, and analysing the scientific data obtained. Throughout this process the students:

- Learn by doing,
- Get acquainted with the inquiry-based methodology that is typical of real-life scientific and technical professions,
- Acquire and/or reinforce fundamental Technology, Physics, and programming curricular concepts,
- Understand the importance of coordination and teamwork
- Enhance their communication skills

## **2 COMPETITION OVERVIEW**

### **CanSat Ireland Competition Phases**

The 2019 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 2019)
- Phase 4 – Winners of the CanSat Ireland Regional competitions prepare for the CanSat Ireland National Final
- Phase 5 – CanSat Ireland National Final (May 2<sup>nd</sup>/3<sup>rd</sup> 2019)

The winners of the CanSat Ireland competition go on to represent Ireland at the European CanSat competition in June 2019.

### **CanSat Ireland Regional Partners**

The CanSat Ireland competition is run in partnership with 8 Institutes of Technology:

Athlone Institute of Technology (AIT),  
Institute of Technology Blanchardstown (ITB)  
Cork Institute of Technology (CIT),  
Dublin Institute of Technology (DIT),  
Limerick Institute of Technology (LIT),  
Sligo Institute of Technology,  
Institute of Technology Tallaght (ITT)  
Institute of Technology Tralee (IT Tralee)



Each institute launches their CanSat Ireland Regional Competition starting off with a Teachers & Mentors workshop in Nov/Dec 2018.

- CanSat Ireland 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 State<sup>1</sup> or an ESA Associate State.
- One teacher/mentor can be responsible for one team per year only.
- The National Final winning team must be able to attend the European CanSat Competition in June 2019
- 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.

### **CanSat Ireland Regional Competitions**

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

Between November 2018 and March 2019, under the supervision of the regional partners, the student teams carry out technical work on their CanSats and engage in outreach activities.

The CanSat Ireland 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;
- Integration and testing of the CanSat;
- Regional launch campaign: Technical & Outreach work.

Regional CanSat Ireland competition finals are scheduled to take place during March 2019.

---

<sup>1</sup> **ESA Member States in 2018:**

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 2018:** Canada, Slovenia

In the framework of the current collaboration agreement between ESA and the Republic of Malta, teams from Malta can also participate in the European CanSat Competition as guest competitors. Teams from other countries may also participate in the European CanSat Competition as guest competitors if approved by ESA



### **Schedule of CanSat Ireland regional competitions**

Athlone Institute of Technology (AIT),	13 <sup>th</sup> March 2019
Institute of Technology Blanchardstown (ITB)	TBC
Cork Institute of Technology (CIT),	9 <sup>th</sup> March 2019
Dublin Institute of Technology (DIT),	21 <sup>st</sup> March 2019
Limerick Institute of Technology (LIT),	TBC
Sligo Institute of Technology,	TBC
Institute of Technology Tallaght (ITT)	TBC
Institute of Technology Tralee (IT Tralee)	TBC

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 Ireland 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 fewer teams competing in the regional final 1 team will qualify for the National Final.

#### **CanSat Ireland National Final**

The CanSat Ireland National Final will take place on 2<sup>nd</sup> and 3<sup>rd</sup> May 2019 at Emo Court Portlaoise (launches in the afternoon of 2<sup>nd</sup> May) and Killeslin Hotel, Portlaoise (presentations on 3<sup>rd</sup> May).

Between March and May 2019, (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 (TBC).



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 Ireland 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 (CDR) Report in advance of the national final.

### **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 completed requirements verification tests
- 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 [rob.osullivan@bco.ie](mailto:rob.osullivan@bco.ie) no later than 5pm on the 26<sup>th</sup> April 2019, 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*.

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 9 June 2019 for the European CanSat Competition.

Submission of a Pre-launch Report of a maximum of 15 pages (written in Verdana font, size 11) to ESA by 9 June 2019, 22:00 CET, summarising all the work done (progress report), providing a full description of the CanSat Ireland 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 in pdf format (written in Verdana font, size 11) 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

**Any additional appendices to the first 15 pages of the document will be excluded from the version of the PLR that will be sent to the jury**

After the launch campaign the teams will be requested to prepare and submit their **CanSat Final Report (CFR)**, which follows the standards of a scientific paper, including an abstract and details of the whole project. The report should be limited to a maximum of 25 pages (excluding appendices) and must summarise the work done before, during, and after the launch campaign, with a special focus on the results obtained and the (scientific/engineering/technical) conclusions. Only after submission of the CFR will the members of the teams receive an ESA certificate recognising their participation in the 2019 European CanSat Competition.

The CanSat Final Report must be submitted to ESA at cansat@esa.int by 14 July 2019, 22:00 CET, stating the name of the team and of the document submitted in the subject line (e.g. "TeamA\_ cansat final report"). The document should be sent in a pdf format, using the following file name format: teamA\_ cansat final report.pdf.

ESA will provide guidelines as well as templates for the required reports to each participating team.

#### **Overview of competition Timeline:**

CanSat Ireland competition dates	
Activity	Date
Launch of CanSat Ireland	October 4 <sup>th</sup> 2018
Contact Schools about participation	November 2018
Kits send to schools	November 2018
Regional finals	March 2019
Critical Design Review report submission	April 26 <sup>th</sup> 2019
National Finals	May 2 <sup>nd</sup> /3 <sup>rd</sup> 2019





### 3 MISSION OVERVIEW

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

#### The rocket launch

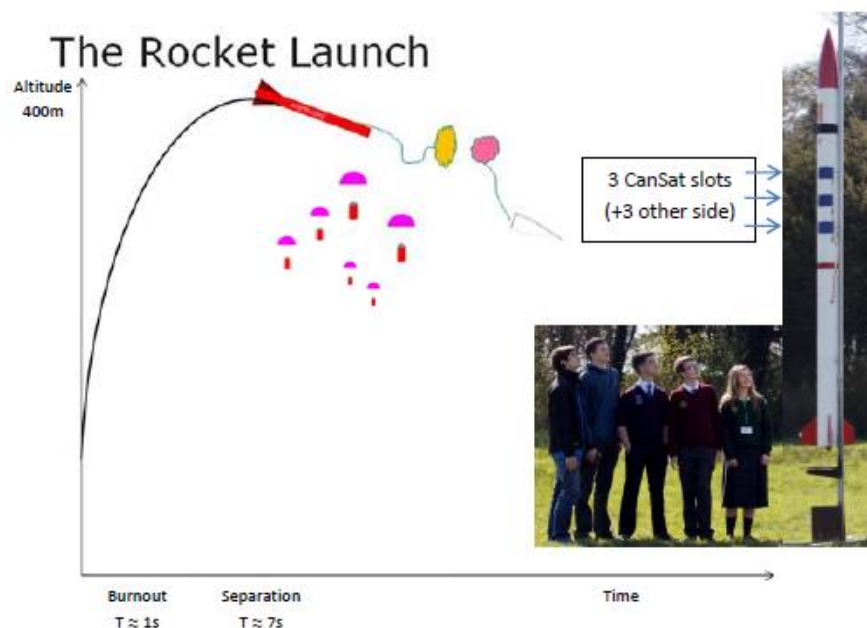
A model rocket will launch the CanSats at the National Final in Emo Court, Portlaoise. CanSat design should adhere to the dimensions below.

The rocket can hold multiple CanSats on board. Rocket specs may vary, but will generally have the following approximate characteristics:

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

The rocket should 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/s<sup>2</sup> in the vertical direction and a maximum velocity of 550 km/h.



## Primary and Secondary CanSat Ireland missions

### Primary mission

The team must build a CanSat and program it to accomplish the following compulsory primary mission:

**To measure, after release and during descent, the following parameters:**

- Air temperature
- Air pressure

**and transmit these data as telemetry to the ground station at least once every second**

During the post-flight analysis, 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 of the CanSat must be selected by the team. Teams can take ideas from real satellite missions, or collect scientific data for a specific project, make a technology demonstration for a student-designed component, or any other mission that would fit inside the CanSat and show its capabilities.

Some examples of missions are listed below, but teams are free to design a mission of their choice, providing they can demonstrate that it has some scientific, technological or innovative value. Teams should also keep in mind the limitations and requirements of the CanSat mission 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 that controls a parafoil, for instance. 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.
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

## CanSat requirements

The CanSat hardware and mission must be designed following these requirements and constraints

- [1] All the components of the CanSat must fit inside a standard soft drink can (115 mm height and 66 mm diameter), with the exception of the parachute. Radio antennas and GPS antennas can be mounted externally on the top or bottom of the can, depending on the design, but not on the sides. 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 500N 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 and 11 m/s is recommended for recovery reasons. However, the CanSat's descent speed must not be lower than 6 m/s or higher than 12 m/s for safety reasons.
- [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. The kit as supplied is valued at €125. 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 assigned frequency must be respected by all teams in the Launch Campaign. The range of allowed frequencies changes depending on the country where the event is hosted and will be



communicated in due time. It is recommended that teams pay attention to the design of the CanSat in terms of hardware integration and interconnection, so the radio frequency can be easily modified if necessary

[17] 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, teams will be evaluated using similar criteria used during the European CanSat competition.

##### Scoring

Performance in the following areas will be evaluated

##### Technical achievement

The Jury will take into account how the teams obtained the results, how reliable and robust the CanSat was, and how the CanSat performed. Innovative aspects of the project will be judged (e.g. the tools selected, and the hardware/software used).

The aspects evaluated will be:

- **Mission's technical complexity:** The CanSat's technical level, understanding of the technical concepts and the originality of the engineering aspects of the mission.
- **Performance of the Primary mission:** The CanSat's technical performance in terms of deployment and data collection for the Primary Mission.
- **Performance of the Secondary mission:** The CanSat's technical performance in terms of deployment and data collection for the Secondary Mission (National Finals only).

##### Scientific Value

The scientific value of the teams' missions and the teams' scientific skills will be evaluated. This includes the scientific relevance of the mission, the quality of the technical reporting (both written and oral) and the team's scientific understanding that will be assessed from the team's ability to analyse and interpret results appropriately.

The aspects evaluated will be:

- **Scientific relevance:** Assessment of whether measurements are done with a clear and well-founded scientific purpose, the extent to which the CanSat is used in an original way and if the data collection is appropriate for reaching the objective.
- **Scientific understanding:** Level of understanding of the scientific principles that underlie the project.
- **Technical reporting:** Ability to summarise with clarity and provide a readable and complete Pre-Launch report, the proper labelling of the graphs and use of the correct units and the ability to present scientifically sound data and interpretations during the launch campaign (National Final only).



### **Professional Competencies**

The Jury will assess the team's collaboration and coordination, adaptability and communication skills. The aspects evaluated will be:

- Teamwork: Collaborative effort of the team in order to complete the tasks in the most effective and efficient way.
- Adaptability: Attitude towards continual improvement and ability to adapt to new conditions, both from the Regional competition towards the National Final (if applicable) and/or as far as ideas for improvement ahead of the European Competition are concerned.
- Communication: Oral presentation skills, the ability to provide a captivating presentation involving confident speaking skills and a visually appealing presentation.

### **Communications/Outreach**

As with all space missions the CanSat mission will require a supporting communications plan which will identify a target audience (e.g. school, local community, local industry/businesses, local primary schools, parents, peers etc) and a strategy for reaching these audiences. A combination of traditional/social media may be used. Web pages, blogs, presentations, promotional material, competitions, and media coverage will be taken into account.

### **Marking scheme**

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

<b>1. Technical achievement</b>	35%
<b>2. Scientific value</b>	35%
<b>3. Professional competencies</b>	20%
<b>4. Outreach</b>	10%
<b>TOTAL</b>	<b>100%</b>

### **Penalties**

Teams' final scores will be penalised in the event of late submission of the CanSat Pre-Launch Report. Similarly, penalties will be applied to teams that exceed the CanSat Ireland budget of €500. Note, the kit as supplied is worth €125 leaving a balance of €375 for the team's maximum budget, assuming the team use the kit provided.





## 5 FUNDING

For the CanSat Ireland National Final 2019, 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 Killeshin Hotel, Portlaoise (presentations)

## 6 CONTACT

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

Stephanie O'Neill, ESERO Ireland Manager;  Science Foundation Ireland, Wilton Park House, Wilton Place, Dublin 2.  Email: <a href="mailto:stephanie.oneill@sfi.ie">stephanie.oneill@sfi.ie</a> Phone: 01 607 3014	Rob O' Sullivan, Project Manager for CanSat 2019  Blackrock Castle Observatory Blackrock, Cork, Ireland.  Email: <a href="mailto:rob.osullivan@bco.ie">rob.osullivan@bco.ie</a> Phone: 021 432 6124
--	--

### **More information**

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

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

CanSat Ireland on Science Space: <https://www.sciencespace.ie/project/cansat-ireland/>

### **Social Media:**

Facebook: [@CanSatIreland](#)

Twitter: [@CanSatIreland](#)

#CanSatIrl2019

