

# **17<sup>th</sup> INTERNATIONAL SPACE CHALLENGE**

## **MISSION BRIEF**

## Challenge Overview

This 17th edition of ISC encourages students globally to imagine living in space!

In this challenge, older students will develop and propose a life science experiment in space, for example by developing an experimental setup to study a biological process in space. The teams will be encouraged to define a mission after a thorough background research. Life sciences team members will have to closely coordinate with engineers, to define all the operational and functional requirements as well as constraints to ensure the success of the mission.

Younger students can take their first step in space by learning about food and nutrition in space.

## 17<sup>TH</sup> ISC THEME LIVING IN SPACE

### Categories

|                                                        | Junior Category                                            | Starter Category                                                                              | Advanced Category                                                                                                                                                                 |
|--------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Age</b>                                             | 9 – 12 years old                                           | 13 – 18 years old                                                                             | 15 – 25 years old                                                                                                                                                                 |
| <b>Objective</b>                                       | Plan a 24 hour meal plan for an astronaut living in space. | Describe how you would perform a meaningful life science experiment in the space environment. | Design a viable experiment that not only pushes the boundaries of our understanding of life or living in space but also holds the potential to improve lives on Earth for humans. |
| <b>Prizes</b>                                          |                                                            |                                                                                               |                                                                                                                                                                                   |
| Top Prize                                              | Top Award Certificate                                      | SGD 2,000 (x1)                                                                                | SGD 10,000 (x1)                                                                                                                                                                   |
| Distinction                                            | Certificate of Distinction                                 | SGD 1,000 (up to 2)                                                                           | SGD 1,000 (up to 2)                                                                                                                                                               |
| Merit                                                  | Certificate of Merit (up to 3)                             | SGD 500 (up to 3)                                                                             | SGD 500 (up to 3)                                                                                                                                                                 |
| Sponsors Award: e.g. Diversity Award, Innovation Award |                                                            | SGD 1,000 for a travel scholarship                                                            |                                                                                                                                                                                   |

\* All ISC participants will get **free entry** to Expand Space

## Eligibility

- Age as of 31<sup>st</sup> December 2024:
  - o Junior: 9 to 12 years old
  - o Starter: 13 to 18 years old
  - o Advanced: 15 to 25 years old
- Teams:
  - o Junior: 1 to 4 members
  - o Start and advanced: 3 to 4 members
- Any educational background, STEM or non STEM
- Any nationality and based anywhere in the world
- Open to students and early career professionals
- Valid e-mail address

## Key Dates

The 17<sup>th</sup> ISC will take place from **February 2024 and end by November 2024.**

The tentative schedule is as follows:

| Dates (2024)               | Activity                                    | Mode                  |
|----------------------------|---------------------------------------------|-----------------------|
| 14 February                | ISC Launch                                  | In Singapore & online |
| 16 February to 1 September | Registration                                | Online                |
| 1 July to 1 September      | Webinars, talks, expert sessions, hang outs | Online                |
| September                  | Mentoring Sessions                          | Online                |
| 30 September               | Project Submissions                         | Online                |
| 11 November                | EXPAND SPACE: Awards Ceremony               | In Singapore & online |

## Communication Channels

All official communication related to the competition will be conducted through the following primary channels:

1. Official website
2. Email addresses provided during registration
3. Space Faculty Learning Portal
4. Discord Server

### Website

Participants are encouraged to regularly check the official competition website at [www.spacefaculty.asia](http://www.spacefaculty.asia) for important announcements, updates, and notifications.

### Email Communication

Important information will be sent to the email addresses provided during registration. Participants must ensure that the email address provided during registration is accurate and regularly monitored. The organizing committee will not be responsible for any consequences arising from participants not receiving important communications due to wrong addresses, unchecked or wrongly filtered emails.

### Space Faculty Learning Portal

Participants are required to join the official Space Faculty Learning Portal at [www.spacefaculty.co](http://www.spacefaculty.co) using the provided invitation link you will receive upon registration. Recordings of the webinars as well as mission brief documents and other relevant slides or data will only be available on our learning portal.

### Discord Communication

A dedicated Discord server will be set up for the competition, serving as a platform for real-time communication, community interaction, and updates. Participants will be able to join the official Discord server using the *provided invitation link upon registration*. Important announcements and clarifications may be made through Discord, and participants are expected to check the relevant channels regularly.

## Introduction

### About the Space Environment

Since the early days of space exploration, the adverse effects of space environment have been apparent. Extreme temperatures, exposure to space radiation and microgravity environment, have shown to affect all living organisms in different ways.

Scientific research on Earth is typically carried out in laboratories fully equipped with state-of-the-art technology spanning several rooms. Traditionally, during life sciences experiments, many procedures are carried out manually by the researchers. In space, resources need to be optimized, experimental steps need to be automated and equipment must be miniaturized.

The space industry is growing steadily and in the past years, humanity has set our sights on establishing a human presence on the Moon, Mars and perhaps even beyond. Thoroughly understanding these adverse effects and potential countermeasures is key to ensure the safety of humans in space. Furthermore, ensuring sustainable and secure food sources, will greatly reduce the weight and therefore cost of launches.

### Space Research Brings Benefits for Life on Earth

Research of life sciences in space, is not only for space exploration, but it can also have great benefits for life on Earth:

- **Humans.** Space offers a unique environment to accelerate research on depressed immune systems, human physiology or even the process of ageing. Ageing has actually been identified as one of UN's Global Issues, urging advancing health and well-being into old age. Taking advantage of these conditions can shed light into certain Earth-based immune deficiencies and potentially lead to novel therapies.
- **Sustainability and food security.** Growing plants in space poses a unique challenge due to the extreme conditions. One such challenge, due to the exposure to cosmic radiation, can lead to randomized epigenetic modifications, understanding these modifications and its effects on plant physiology through generations is still a subject of investigation. Furthermore, technologies developed to grow plants in space, can be adopted back on Earth, leading to more efficient and sustainable use of resources to grow crops.

### Life Sciences

Life sciences encompasses all the disciplines concerned with the study of living organisms, including (but not limited to) biology, botany, zoology, bioengineering, microbiology, physiology, biochemistry, biomedical engineering, and related subjects. In your mission design, you may include any of those as the subject of your mission. However, it is recommended that you focus only on one subject (that is, either a plant type or animal type, including human, or a specific cell type or system) for your mission to provide enough depth in your proposal.

Designing an experiment to study life sciences in space will not only require knowledge in life sciences but also in other disciplines such as engineering, finance or ethics, among others. Make sure to form a diverse team!

## Junior Category

### Challenge Statement

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***Design a menu for astronauts living in space for a full 24 hours***

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### Objectives

- Learn about how astronauts eat in space
- Explore how food is prepared for space consumption
- Learn how food is packaged to be sent
- Learn the importance of a balanced diet and nutritional aspects of food

### Deliverables

- Poster or document in any format (digital or hand made)
  - o For hand-made posters students should submit a high resolution picture of it
  - o Include the nutritional information for the whole menu
    - Calories
    - Fat
      - Saturated
      - Trans
    - Cholesterol
    - Sodium
    - Carbohydrates
      - Fiber
      - Sugars
    - Protein
    - Others (vitamins, iron, calcium,...)
  - o It can include images
- Optional: prepare one or all of the meals!

## Judging Rubrics (Junior Category)

| Criteria & Assessment                                                                                                                                                                                                                                                                                                               | Max Points          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b><i>Creativity</i></b> <ul style="list-style-type: none"> <li>- Novelty of the meals (5 points)</li> <li>- Potential for implementation (5 points)</li> </ul>                                                                                                                                                                     | 20                  |
| <b><i>Nutritional Content</i></b> <ul style="list-style-type: none"> <li>- The menu meets the nutritional needs of an astronaut living in space (15)</li> <li>- The menu provides key vitamins and minerals (10)</li> </ul>                                                                                                         | 25                  |
| <b><i>Menu feasibility</i></b> <ul style="list-style-type: none"> <li>- Sourcing ingredients (5 points)</li> <li>- Ease of preparation in space (5 points)</li> <li>- Ease of transport to space (e.g. weight) (5 points)</li> <li>- Packaging (5 points)</li> <li>- Ease of consumption in space (5 points)</li> </ul>             | 25                  |
| <b><i>Ethical and Sustainability Considerations</i></b> <ul style="list-style-type: none"> <li>- The menu considers ethical and sustainable ingredients and packaging. (10 points)</li> </ul>                                                                                                                                       | 10                  |
| <b><i>Entry Submission</i></b> <ul style="list-style-type: none"> <li>- <b>Poster or document:</b> shows all the required information in a clear manner (10 points)</li> <li>- <b>Submission creativity</b> (10 points)</li> </ul>                                                                                                  | 20                  |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                        | <b>100</b>          |
| <b><i>Bonus Points</i></b><br><u>Prepare the menu (10 points)</u> <ul style="list-style-type: none"> <li>- Prepare a meal or the whole menu</li> <li>- Present the prepared meal or menu at Expand Space (10 points)</li> <li>- Show pictures or take a video explaining the menu and the reasoning behind it (5 points)</li> </ul> | <b>Up to<br/>10</b> |

## Starter Category

### Challenge Statement

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***Describe how you would perform a meaningful life science experiment in the space environment***

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### Deliverables

- Written experiment report no longer than 10 pages (not including Cover Page, Content Page, References and Annex)
- A1 Research poster explaining your project
- *Optional:* mock up of your experiment

### Your report should include

- Abstract
- State of the art and literature review.
- Clearly defined objectives of your experiment. That is, why are you doing this experiment?
- Space is vast. You should define your space environment and illustrate the conditions of the environment you are operating in, particularly which space conditions your experiment will require (e.g. radiation, microgravity, vacuum, Moon gravity, etc).
- Contrast the Earth's environment with the space environment to justify your design.
- Clear articulation of the merits of your design and proposal
- An experimental setup/methods section explaining the different components and subsystems of the experiment.
- Cite the trade-off and disadvantages of your design and your justifications for making the trade-off(s)
- Expected or preliminary (if available) results
- Conclusions and references

### *Optional*

- Illustrate how the idea could provide benefits back on Earth.
- You are encouraged to design an experiment that has a high degree of automation, this means that human (astronaut) interaction with the scientific experiment should be as little as feasibly possible.
- Run the proposed experiment on ground to obtain preliminary results, and present the results clearly in the submission or through other medium.



## Judging Rubrics (Starter Category)

| Criteria & Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Max Points |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>Scientific Relevance</b> <ul style="list-style-type: none"> <li>- Significance of research findings or experiments, contributing valuable insights to existing knowledge and advancing our understanding of the world of science</li> <li>- Scientific background on the topic of study is well researched (5 points)</li> <li>- Research proposal is scientifically sound and relevant (5 points)</li> <li>- Proposal considers environmental effects (radiation, microgravity, vacuum, temperature...) (5 points)</li> <li>- Experimental methods and experimental setup are clearly explained. (5 points)</li> </ul> | 25         |
| <b>Creativity</b> <ul style="list-style-type: none"> <li>- Idea, concept, design, and creativity (9 points)</li> <li>- Disruptive potential of idea (7 points)</li> <li>- Understanding and justification behind the use of such technologies (9 points)</li> </ul>                                                                                                                                                                                                                                                                                                                                                        | 25         |
| <b>Project Viability</b> <ul style="list-style-type: none"> <li>- Concept and technological viability.</li> <li>- The experiment can be carried out in space with or without human interaction (5 points)</li> <li>- Identification and allocation of financial and manpower resources to tasks (5 points)</li> <li>- Development of realistic project timeline demonstrated with Gantt chart (3 points)</li> <li>- Understanding of potential risks and challenges and use of risk matrix (2 point)</li> </ul>                                                                                                            | 15         |
| <b>Environmental, Ethical and Sustainability Consideration</b> <ul style="list-style-type: none"> <li>- Report reflects commitment to sustainable and ethical practices and considerations, such as environmental impact, social responsibility, and compliance with ethical standards (10 points)</li> </ul>                                                                                                                                                                                                                                                                                                              | 10         |
| <b>Entry Submission</b> <ul style="list-style-type: none"> <li>- <b>Report:</b> Content of report is easy to read, and submission is well-structured and organized, using headings and sub-headings. Clear introduction and conclusion with logical flow between sections (3 points), relevant figures, illustrations, and graphics (2 points). Report includes referencing (3 points) and is proofread (2 points)</li> <li>- <b>Research Poster:</b> poster adheres to competition guidelines (A1 size) (2 points), clarity and conciseness (5 points), poster design (3 points)</li> </ul>                               | 20         |
| <b>Future Opportunity on Earth</b> <ul style="list-style-type: none"> <li>- Clarity and sound presentation of how the proposed experiment can be directly applied to enhance human life on Earth in the next decade.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                            | 5          |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>100</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| <p><b>Bonus Points</b></p> <p><u>Run the experiment on Earth (10 points)</u></p> <ul style="list-style-type: none"> <li>- Perform the experiment on Earth.</li> <li>- High degree of experiment automation.</li> <li>- Provide reports on the results and useful insights.</li> <li>- Provide visuals (photographs, mock ups, videos) of the experiment on Earth.</li> </ul> <p><u>Mock Up &amp; Video (10 points)</u></p> <ul style="list-style-type: none"> <li>- Team has prepared a mock up. Mock up can be presented in person during <b>Expand Space</b> (10 points) or over a video recording (5 points) for international students (up to 3 minutes)</li> </ul> <p><u>Social media (5 points)</u></p> <ul style="list-style-type: none"> <li>- At least 5 social media posts on one of the following: Instagram, LinkedIn, Discord. Space Faculty's account must be tagged, and these hashtags must be used in the post: #SpaceFaculty, #ISC #ISC17 #17thISC #ExperimentLearnLead, #InternationalSpaceChallenge, #ExpandSpace</li> </ul> | <p><b>Up to<br/>25</b></p> |
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## Advanced Category

### Challenge Statement

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***Your mission is to design a life science experiment that not only pushes the boundaries of our understanding of living in space but also holds the potential to improve lives on Earth for humans***

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### Deliverables

- Written experiment report no longer than 40 pages (not including Cover Page, Content Page, References and Annex)
- Video presentation explaining your project – (8 minutes)
- Optional: mock up of your experiment

### Your report should include

- Abstract
- State of the art and literature review.
- Clearly defined objectives of your experiment. That is, why are you doing this experiment?
- Space is vast. You should define your space environment and illustrate the conditions of the environment you are operating in, particularly which space conditions your experiment will require (e.g. radiation, microgravity, vacuum, Moon gravity, etc).
- Contrast the Earth's environment with the space environment to justify your design.
- Clear articulation of the merits of your design and proposal.
- A methods section explaining the different methods used in your experiment (microscopy, flow cytometry, gene analysis, etc) – note that this section is related to the relevant *life science's methods*.
- An experimental setup explaining the different components and subsystems of the experiment. The experiment should be as automated as feasibly possible, this means that human (astronaut) interaction with the scientific experiment should be as little as possible. – note that this section is related to *technical aspects of the experiment*.
- Cite the trade-off and disadvantages of your design and your justifications for making the trade-off(s).
- Expected or preliminary (if available) results in space.
- Clear articulation of how the outcomes or process of the proposed experiment can be directly applied to enhance human life on Earth in the next decade. Think about health, sustainability, or quality of life improvements and how your experiment can be a catalyst for positive change.
- Conclusions and references.

### Optional

- Run the proposed experiment on Earth and present the results clearly in the submission or through other medium.

## Judging Rubrics (Advanced Category)

| Criteria & Assessment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Max Points |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>Scientific Relevance</b> <ul style="list-style-type: none"> <li>- Significance of research findings or experiments, contributing valuable insights to existing knowledge and advancing our understanding of the world of science</li> <li>- Scientific background on the topic of study is well researched (5 points)</li> <li>- Research proposal is scientifically sound and relevant (5 points)</li> <li>- Proposal considers environmental effects (radiation, microgravity, vacuum, temperature...) (5 points)</li> <li>- Experimental methods and experimental setup are clearly explained. (5 points)</li> </ul>    | 20         |
| <b>Project Viability</b> <ul style="list-style-type: none"> <li>- Concept and technological viability.</li> <li>- The experiment has a high degree of automation and can be done with limited human interaction (5 points)</li> <li>- Identification and allocation of financial and manpower resources to tasks (5 points)</li> <li>- Development of realistic project timeline demonstrated with Gantt chart (3 points)</li> <li>- Understanding of potential risks and challenges and use of risk matrix (2 point)</li> </ul>                                                                                              | 20         |
| <b>Entry Submission</b> <ul style="list-style-type: none"> <li>- <b>Report:</b> Content of report is easy to read, and submission is well-structured and organized, using headings and sub-headings. Clear introduction and conclusion with logical flow between sections (3 points), relevant figures, illustrations, and graphics (2 points). Report includes referencing (3 points) and is proofread (2 points)</li> <li>- <b>Video:</b> Submission of video presentation of up to 8 minutes. A mock up can also be included in the video presentation for teams submitting an online presentation. (10 points)</li> </ul> | 20         |
| <b>Innovation</b> <ul style="list-style-type: none"> <li>- Idea, concept, design, technical innovation, and creativity (10 points)</li> <li>- Disruptive potential of idea (10 points)</li> <li>- Understanding and justification behind the use of such technologies (5 points)</li> </ul>                                                                                                                                                                                                                                                                                                                                   | 15         |
| <b>Environmental, Ethical and Sustainability Considerations</b> <ul style="list-style-type: none"> <li>- Report reflects commitment to sustainable and ethical practices and considerations, such as environmental impact, social responsibility, and compliance with ethical standards (10 points)</li> </ul>                                                                                                                                                                                                                                                                                                                | 10         |
| <b>Future Opportunity on Earth</b> <ul style="list-style-type: none"> <li>- Clarity and sound presentation of how the proposed experiment can be directly applied to enhance human life on earth in the next decade. (10 points)</li> <li>- Demonstrates an understanding of potential market dynamics, target customers, and competition. Providing clear business projections, return on investments, revenue, costs, profitability etc (5 points)</li> </ul>                                                                                                                                                               | 15         |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>100</b> |

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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| <p><b>Bonus Points</b></p> <p><u>Run the experiment on Earth (15 points)</u></p> <ul style="list-style-type: none"> <li>- Perform the experiment on Earth.</li> <li>- Provide reports on the results and useful insights.</li> <li>- Provide visuals (photographs, mock ups, videos) of the experiment on Earth.</li> </ul> <p><u>Mock Up &amp; Video (10 points)</u></p> <ul style="list-style-type: none"> <li>- Team has prepared a mock up. Mock up can be presented in person during <b>Expand Space</b> (10 points) or over a video recording (5 points) for international students (up to 3 minutes)</li> </ul> <p><u>Social media (5 points)</u></p> <ul style="list-style-type: none"> <li>- At least 5 social media posts on one of the following: Instagram, LinkedIn, Discord. Space Faculty's account must be tagged, and these hashtags must be used in the post: #SpaceFaculty, #ISC #ISC17 #17thISC, #ExperimentLearnLead, #InternationalSpaceChallenge, #ExpandSpace</li> </ul> | <p><b>Up to<br/>30</b></p> |
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## Rules and Regulations

### Teams

- Junior: 1 to 4 members
- Starter and Advanced: 3 to 4 members
- If your team has less than 3 members, we can help you connect with other participants
- Ages (as of 31 December 2024):
  - o Junior: 9 to 12
  - o Starter: 13 to 18
  - o Advanced: 15 to 25
- Located anywhere in the world
- Any nationality
- From a specific institution or “Independent” if the members are from different institutions
- Participants can join from any educational background (STEM or non-STEM), teams with mixed backgrounds are encouraged.
- Team Name: make sure you choose a good name and remember it! If you win your team’s name will be called!
- Failure to adhere to ISC’s Rules & Regulations can result in team disqualification.

### Plagiarism

- Reports will be checked for plagiarism, and teams with plagiarised content and ideas will be penalized.

### Generative AI

- The use of generative AI (e.g. ChatGPT, Gemini, Copilot, DALL-E, etc.) is allowed for content, image, or video creation within reason, however participants **must include** a section detailing **which parts of the report have benefited from Generative AI** and the **prompts used** to this end.
- Note that **this is mandatory** if you have used GenAI, failure to do include this statement will be penalized when use of Generative AI is detected by the review committee.
- Heavy and non-critical use of such tools (even if reported) will be penalized.

### Language

- Reports, posters and presentations must be submitted in English.

### Intellectual Property

- Space Faculty will not retain the intellectual property rights of the submitted ideas, however Space Faculty reserves the right to use certain materials for marketing purposes.

### Prizes

- Prizes worth up to SGD 25,000 distributed amongst the winners of the different categories.
- Participation Certificates by Space Faculty and supporting organizations.