Fluid Behavior and Droplet Dynamics of Tampon Removal in Microgravity

Proposal for Canadian Reduced Gravity Experiment Design Challenge

By SPACE MENs

("Space Menstruators")

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1.0 Introduction

1.1 Research Motivation

Despite the fact that over 75 women astronauts have taken part in space missions [1], there remains an overwhelming lack of research and established best practices to address menstrual health and hygiene in space. While space agencies like the Canadian Space Agency (CSA) and the National Aeronautics and Space Administration (NASA) diligently prepare for missions and must consider a multitude of different human health factors, the consideration of women's menstruation in microgravity environments remains largely unexplored [2].

There are a few key studies and statistics related to how female astronauts currently manage menstruation in space, but overall, this remains an under-researched area. Reportedly, the most common solution currently used by female astronauts is menstrual suppression [3]. The decision to suppress one's menstrual cycle, typically through some combination of progesterone and/or estrogen, is dependent on a multitude of personal health factors and risk in experiencing abnormal uterine bleeding, ovarian cyst production, change in bone mineral density, and breast/uterine/ovarian cancer [2].

When female astronauts do choose to menstruate in space, they typically rely on tampons and sanitary pads, much like they do on Earth. While tampons work, we have found there is a lack of published studies on the fluid mechanics of blood removal and disposal in microgravity, which introduce risks for hygiene and disposal. The choice to use menstrual products also may impact flight characteristics, such as onboard mass, volume, and other engineering considerations for disposal and sanitation.

On Earth, gravity plays a foundational role in the effectiveness of menstrual products to absorb and retain fluid. As liquids tend to form floating droplets in microgravity due to surface tension, there remains no best disposal methods for saturated tampons and menstrual products [3].

Understanding how various tampon brands handle fluid dispersion in microgravity is essential to creating safe, practical solutions for the next generations of astronaut women who will require this research for long-haul space flights, where suppressing menstruation may not be an available option. Furthermore, it would allow female astronauts, physicians, and engineering teams, (all relevant stakeholders to space mission preparation) to knowledgeably develop effective protocols for the disposal of tampon products.

Thus, the aim of this study is to review the droplet dispersion and characterize the fluid release that may occur when a female astronaut removes their tampon in a microgravity environment. It would do so by conducting trials during a parabolic flight, utilizing four popular tampon brands that would be fully saturated in a blood simulant. Each trial will consist of a saturated tampon being removed from a synthetic vagina, (hereby referred to as 'syngina' as is colloquially used in academic menstrual product research), with a high-resolution camera being used to detect droplets for later analysis.

NASA's infamous 1983 misstep, where engineers asked astronaut Sally Ride if 100 tampons would be enough for a week-long space mission, highlights how poorly understood menstruation in space was at the time. While space agencies have made strides since then, the hygiene and fluid dynamics of menstruation in microgravity is still required through study.

Women's health research has historically been underfunded and overlooked, both on Earth and in space. Despite women making up nearly half of the astronaut corps, there is a striking lack of dedicated studies on female-specific concerns. This gap is a part of a broader trend, where women's health needs– especially in high-stakes environments like space– are consistently under-researched. Addressing this imbalance is essential for the future of inclusive space exploration.

1.2 Novelty of Experiment

The management of menstruation in space has primarily relied on hormonal methods [4]. This approach has been well-established and it is often noted in literature: "There is a long history of continuous COC use during spaceflight missions and training. It is safe and reliable for effective contraception and menstrual suppression" [5]. However, this does not mean that other methods should not be considered for the astronaut population. This focus on hormonal methods has left gaps in our understanding of alternative approaches.

Research into non-hormonal menstrual management in space has been sparse and provides little relevance to sanity consideration. One notable experiment was the "Astro-Cup," where "two menstrual cups launched toward space… on the Portuguese rocket Baltasar, experienced a few minutes of microgravity, then came back down" [6]. This was primarily a materials research experiment and provided no insight into controlled use in space or comparative sanitary effectiveness.

The limited focus on non-hormonal methods has left significant gaps in our understanding. These include:

1. Relative sanity success of tampons or pads in fluid retention microgravity environments, and
2. Dynamics and potential sanitary concerns for non-hormonal menses products used in micro-gravity for long-term flight.

While some research has been conducted on related topics, it remains limited. For instance, "There is a single published, controlled study of the pharmaceutical stability of a hormonal medication in space" [4]. Additionally, some work has been done on waste processing: "NASA

Marshall Space Flight Center (MSFC) experts performed breakthrough and precipitation tests with blood-laced urine for analysis" with results "suggestive that ISS WHC and WRM hardware should be capable of reclaiming urine from a female during menstruation without incident" [3]. But again it gives little context to the relative sanity success of considerations of non-hormonal menstrual management solutions.

The need for more comprehensive research is clear and best stated as, "Offering female astronauts up-to-date, evidence-based, comprehensive education, in view of the environment in which they work, would empower them to make informed decisions regarding menstrual suppression while respecting their autonomy" [5]. This principle extends beyond menstrual suppression and requires research into the full range of menstrual management solutions.

Our research addresses these gaps by studying how well different tampon brands can retain fluid (and not have droplets coming off) while being taken out of a syngina in space/microgravity. We're characterizing their performance by how many droplets come off each tampon. This approach provides valuable data on the effectiveness of tampons in microgravity, contributing to the development of safer, more efficient menstrual management solutions for future space missions.

1.3 Goals

Before the enactment of the Civil Rights Act of 1964, which outlawed sex-based discrimination, scientists and researchers had originally deemed women unfit for spaceflight due to their lack of understanding of the menstrual process. The disinvolvement of women in academic research has propagated larger gaps in women's health research, which extends to space science [2].

Our aim is to address these gaps by extending research beyond terrestrial confines and into outer space, focusing on female astronauts who opt for non-hormonal menstrual management. Ultimately, this research should better characterize fluid properties and characteristics regarding their absorption and retention in tampons, for future protocols in disposal and sanitation of tampons can be created. Listed below are the primary goals of the mission:

1. **Observe Droplet Dispersion Dynamics:** Study the behavior of menstrual fluid dispersion by fully saturated tampons under microgravity conditions.

2. **Evaluate Tampon Performance in Microgravity:** Assess how various tampon brands manage fluid dispersion and absorption in a simulated zero-gravity environment.

3. **Identify Performance Gaps:** Highlight any deficiencies, limitations, or malfunctions in tampon performance and suggest areas for development.

4. **Establish a Baseline for Menstrual Hygiene Products in Space:** Provide data to support or refute the use of tampons in space and encourage the exploration of alternative hygienic products or methods if necessary.
5. **Enhance Women's Health Research:** Encourage further research to improve menstrual product design and application for female astronauts.

1.4 Importance to Canada's Space Sector

This study supports the Canadian Space Agency's 2024-2025 Departmental Plan by contributing to several of their investment framework priorities, including:

i) Space information and technology improves the lives of Canadians:

This research carries significant value for Canada's space sector by demonstrating commitment to conducting gender-inclusive research and engineering, particularly by addressing an issue that disproportionately affects women. In tackling an area that has been historically under-researched, this study not only elevates the standard of health and safety for future missions but also positions Canada as a leader in advocating for comprehensive human factors research in space.

All Canadians benefit from encouraging and practicing inclusive design in academia, particularly for human health research and engineering design, areas where women have historically been underrepresented.

This can be measured quantitatively by the number of team members involved in Space MENs who will carry this inclusive design experience within their professional careers in contributing to the Canadian space economy. Furthermore, the number of students and youths who participate in Space MENs outreach coordination will also be a quantitative measure of the improvement in the lives of Canadians.

ii) Canada remains a leading space-faring nation:

Canada is recognized as a leading spacefaring nation, with a long-standing commitment to fostering innovation and maintaining a competitive edge in global space exploration. This research directly supports the Canadian Space Agency's (CSA) strategic priorities by contributing to knowledge that will be essential for future long-duration missions, such as those to the Moon and Mars, where access to medical resources is limited and suppression of menstruation may not be an option.

Through its Departmental Plan, the CSA aims to improve the lives of Canadians by advancing space information and technologies that promote health, safety, and sustainability. This experiment aligns with those objectives by addressing an essential aspect of astronaut health and hygiene, which could have applications both in space and in remote or resource-limited environments on Earth.

This can be measured by the number of publications made from data recovered in this study.

iii) Canada's investments in space benefits the Canadian economy:

Moreover, Canada's investment in this research also has broader economic and social impacts. Space health research drives innovation, stimulating advancements in medical technologies, waste management, and materials science that benefit both the space sector and the Canadian economy.

By leading this study, Canada can foster new partnerships, attract talent, and contribute to international collaborations, reinforcing its reputation as a forward-thinking leader in space exploration. The knowledge gained from this experiment will not only improve the safety and well-being of female astronauts but also strengthen Canada's role in making space a more inclusive frontier for all.

This outcome may be measured by the number of team members involved in Space MENs who will carry this technical experience into their professional careers in engineering and space science.

1.5 Relevance to Reduced Gravity

The proposed experiment requires a parabolic flight to effectively simulate microgravity and examine the dispersion of menstrual fluids during tampon removal in a space-like environment. Other methods, such as drop towers or rocket freefall, do not offer the necessary conditions for this experiment due to limitations in duration and human involvement.

Firstly, the key scientific objective of this experiment is to study the droplet dispersion dynamics of menstrual fluid under microgravity, a process which is highly dependent on human input for observation and adjustments. The unique setup, involving the removal of tampons from the syngina, requires the operator's real-time handling of equipment and monitoring of fluid splatter and absorption. Unlike a drop tower or rocket freefall, where experimental timeframes are extremely short (typically less than 10 seconds), a parabolic flight provides multiple rounds of microgravity lasting approximately 20 seconds per parabola, giving the necessary flexibility to set up, adjust, and execute the experiment over multiple cycles.

Additionally, the sensitive nature of the experiment equipment—such as the high-speed camera used to capture fluid dispersion and the white paper linings for droplet collection—further limits the feasibility of alternative methods. Free-fall setups in drop towers or rockets might result in equipment damage or insufficient control over environmental conditions. In contrast, a parabolic flight allows for a controlled environment in which the team can safely operate the camera, tampons, and fluid capture system while experiencing repeated phases of microgravity.

Furthermore, while only 20 seconds of microgravity are necessary to observe fluid release upon tampon removal, the extended time between parabolas allows the team to properly set up each trial and ensure that the camera and other instruments are correctly positioned. This cyclical nature of parabolic flight ensures that the experiment can be conducted across multiple rounds, allowing for more data collection and consistent results.

In conclusion, parabolic flight is the most suitable platform for this experiment due to its unique ability to provide sustained microgravity periods, facilitate human input, and protect sensitive equipment. The 20-second windows per parabola are sufficient to observe and measure the fluid dynamics, while the intervals between parabolas allow for proper setup and adjustments.

1.6 Research Hypothesis

The extraction of a saturated tampon in microgravity leads to coalescence of menstrual fluid at the vaginal opening, causing droplet formation, which presents a sanitary risk in such environments.

In microgravity, the absence of gravitational forces enhances the influence of surface tension on liquids, such as menstrual fluid. When a tampon is extracted from the vaginal cavity, it is hypothesized that menstrual fluid will coalesce at the opening of the cavity, leading to the formation of droplets. This behavior is due to the tampon's design, which expands to conform to the contours of the vaginal wall. During removal, the process may create a pressure gradient along the tampon’s axis, and the frictional forces at the cavity seam may result in uneven fluid flow. This could cause fluid to accumulate toward the tampon’s tip, resulting in higher saturation in that region. The increased saturation at the end of the tampon may heighten the risk of fluid pooling and subsequent droplet formation when the tampon is fully removed.

Given that menstrual fluid poses a biohazard risk, such fluid droplet formation is undesirable in controlled microgravity environments like those found on space missions. This hypothesis is testable through experimentation using synthetic vaginal models to simulate tampon extraction under microgravity conditions. Testing could include various tampon brands and products to assess factors such as volume displaced during removal, the number of droplets formed, and droplet size distribution in the surrounding area. These experiments would help determine how different tampon designs influence fluid behavior in microgravity.

2.0 Experiment Concept Design

2.1 Scientific Objectives

The primary objective of this experiment is to study the hygienic conditions of removing tampons in a microgravity environment. It focuses on studying the splatter and dispersion of menstrual fluids within microgravity, and how it differs from an earth-like gravity environment. Success in the experiment will be measured by the amount of fluid released by the tampon on removal in microgravity in comparison to regular gravity.

To measure the objectives, two teams will simultaneously conduct the same experiment, each within their own clear plastic housing unit. This housing unit will contain all the experimental equipment, as well as white paper linings within one face of the wall opposing a camera that will be mounted.

The camera will record at a high frame rate with a macro photography lens, with a goal of recording droplets being released upon removal of the tampon from the syngina. Computer vision techniques will be used to count these droplets and analyze the release patterns. Further measurement will be recorded on the walls of the experiment apparatus. Since the walls will be lined with white paper, they will be able to capture fluid droplets as they splash against them during the second 2g pull. As the synginas will be sealed, the droplets on the outer paper will be an accurate trace of fluid released upon removal.

Overall, these objectives will seek to illustrate hygiene concerns for long term space flight with existing menstrual products. Release of menstrual fluids in space can lead to problems with fluids getting into equipment, or contaminating urine recycling systems. For long haul space flight, where stopping menstruation completely is not a preferrable option, the suitability of current menstrual products must be studied. If there is potential for menstrual fluid to be released into the surrounding environment, then there is potential for bacteria growth or equipment that must be mitigated. This study will establish whether existing menstrual products are suitable for long haul space flight or if new alternatives or new materials must be investigated.

2.2 Science Traceability Matrix

Through the mission, we evaluate the effectiveness of existing tampon brands in space conditions. By observing the fluid dispersion dynamics and splatter patterns that occur in the removal process, and measuring absorbance power, we can determine whether or not existing hygienic products call for further enhancement or alteration. All scientific objectives align with the Goals described in Section 1.3.

Table 1: Science Traceability Matrix (STM)

Scientific Objective A specific line of investigation that supports the overall Mission Goal	**Scientific Measurement**		**Scientific Instrument**	
	Measurement Objective Description of an observable physical phenomena that is key to understanding the Scientific Objective	**Measurement Requirement** Definition of the minimum measurement of characteristics required to meet the Scientific Objective	**Instrument** Name of the tool that is required to conduct the measurement	**Instrument Requirement** Definition of the minimum instrument performance metrics to meet the measurement requirement
Simulate the removal of a saturated tampon in micro-g	Insert wetted tampons into a synthetic vaginal model	Clean insertion of fully saturated tampons without spillage	Speculum Syngina	N/A
Compare liquid splatter amounts through visual tooling	Splatter of blood simulant from removal process	Observable quantity of droplets	Sony A7SIII Mirrorless Camera 90mm F/2.8 G Macro Lens	4k resolution, 120 frames/second
Measure the absorbance of various tampon brands	Record mass of dry and wetted tampons on earth prior to and after mission launch	Change in mass of wetted tampon	Mass scale	±0.01g Precision 0.01g Resolution 0-100g Range

Mission Requirements Describe the scenario that must occur to result in a successful measurement for the mission.
Prior to microgravity conditions, saturated tampons will be removed from cylindrical casings and inserted into the synthetic vaginal models using a speculum. Once in micro-g, each tampon is removed by one mission specialist while another conducts video monitoring of the removal process. The tampon is then discarded neatly and the process repeats. Both loading and removal must be completed in less than 20 seconds.

2.3 System Architecture

This experiment aims to study the behavior of menstrual products in microgravity. It utilizes a series of containers to simulate the vaginal environment and control liquid flow. The procedure involves repeatedly testing various menstrual products, with primary data collection through video monitoring. The goal is to characterize splatter patterns and sanitary performance in space conditions.

The setup consists of 4 main systems. Three of these systems are mechanical and one is electrical. Each system can be seen as color-coded in Figure 1.

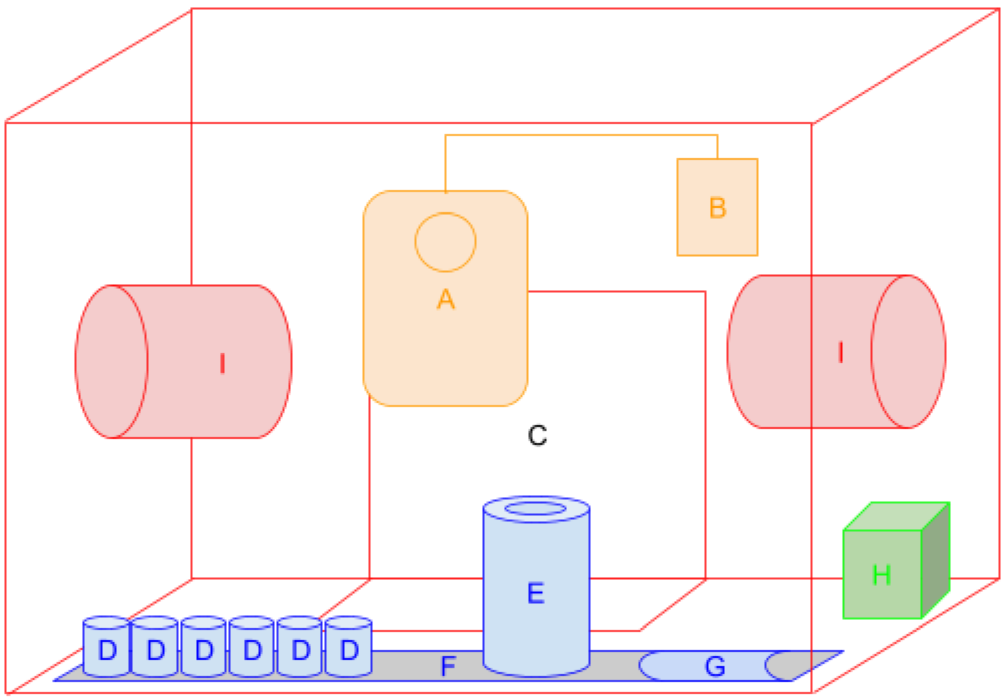

Figure 1. System Architecture

Table 2: System Architecture and Descriptions

Item	Description
A	High-Speed Camera
B	Camera Battery System
C	White Paper Background
D	Saturated Tampon inside Lidded Liquid Container

E	Syngina
F	Velcro Strip
G	Speculum
H	Waste Disposal Container

The system shown in blue includes a single syngina (synthetic vaginas) (Item **E**), lidded containers, each containing a regular-flow tampon that is fully saturated by a blood simulant (Item **D**s), a velcro strip (Item **F**), and a speculum (Item **G**). The syngina model used will be made of stretchy latex material to simulate vaginal walls and house wetted. To control equipment during micro & hyper-gravity, the velcro strip will be used to adhere equipment. Finally, the speculum will insert and remove materials from the syngina.

The system shown in red is the primary housing for the system that includes access via surgical gloves (Item **I**) and a white paper background (Item **C**). All fluid and experimental procedures will be contained within this primary container. Access to the experimental space will be controlled via the glove interface. The white paper background provides image contrast during the experimental procedure.

The system shown in green (Item **H**) acts as the cleanup solution to manage wet materials and excess liquid during the experiment.

The primary and only electrical system is shown in orange and includes a high-speed camera (Item A) and battery system (Item **B**). The key electrical element is a high-quality camera (such as a Sony Alpha 7S III) with high fps capability and a macro lens. This setup ensures a detailed capture of fluid dynamics. The camera will be externally mounted on the primary housing to prevent fluid contamination.

The core of the experiment revolves around high-speed camera recordings. Post-experiment analysis will employ image processing techniques to extract splatter patterns and perform volumetric analysis. This approach allows for a comparative analysis of different materials or brands, assessing their ability to retain fluid and their behavior when compressed in microgravity.

2.4 Block Diagram

A block diagram that supports the system architecture is shown below, which represents the mechanical and electrical components of our experiment:

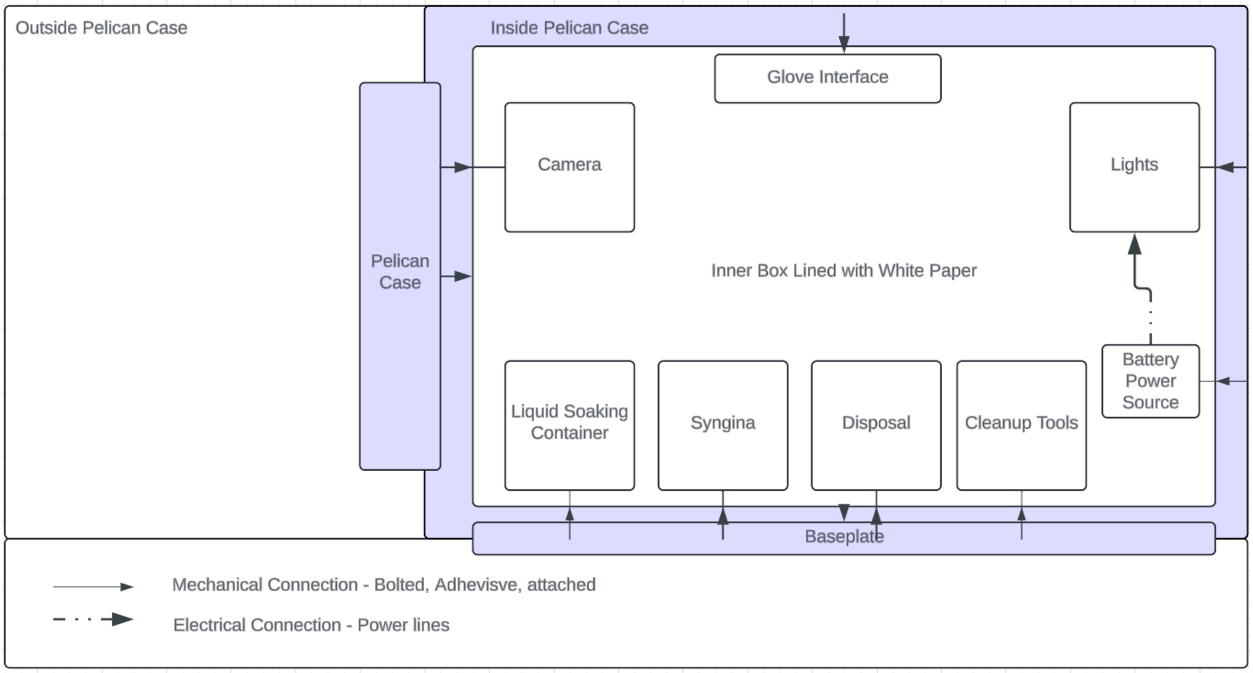

Figure 2: Block Diagram of System Architecture

3.0 Concept of Operation

3.1 Equipment Requirements

In order to meet the scientific objectives outlined in the STM, specific equipment was identified based on the equipment requirements. The following table outlines the equipment required for each scientific objective to be met, as well as where we may acquire the equipment from.

Table 3: Equipment Requirements Summary

Scientific Objective	Equipment Requirements	Equipment Name	Procured From
Simulate the removal of a saturated tampon in micro-g	· Accurate anatomical model of a vaginal canal · Device to facilitate tampon insertion and minimize spillage	· Venus Pelvic Health Anatomical Model · Vaginal speculum	· Online from www.granvillebiomedical.ca · Online from shop.cardinalhealth.ca
Compare liquid splatter amounts through visual tooling	· 4K and 120 frames per second camera · Magnification lens	· Sony A7SIII Mirrorless Camera · 90mm F/2.8 G	Both can be rented from a local video rental store

		Macro Lens	www.video.equipment
Measure the absorbance of various tampon brands	±0.01g Precision 0.01g Resolution 0-100g Range	Digital gram scale Toprime 500g 0.01g Food Scale	Online from Amazon.ca

3.2 Environmental Requirements

Several environmental conditions at the integration site and during the parabolic flight pose potential risks to the successful execution of our scientific objectives. The following outlines key risks and the corresponding mitigation strategies are summarized in the following table, with an in depth explanation for each Risk Number proceeding it.

Table 4: Environmental Requirements Summary

Risk	Description	Likelihood (Before Mitigation)	Severity (Before Mitigation)	Mitigation Strategy	Likelihood (After Mitigation)	Severity (After Mitigation)
1. Vibrations during the Parabolic Flight	Vibrations may cause misalignment of experimental equipment, potentially affecting data accuracy.	Medium	High	Secure equipment with Velcro and mounting brackets, handle with care, realign if needed during flight intervals.	Low	Low
2. Hypogravity Effects on Tampon Saturation	Inconsistent fluid saturation due to hypogravity may skew droplet analysis during microgravity.	Medium	Medium	Use mass analysis post-flight for accurate measurement; use a speculum to prevent fluid leakage during the trial.	Low	Low
3. Pressure Effects on Battery Selection	Pressure changes in the aircraft may affect battery performance, causing equipment malfunction.	Low	Low	Use plastic housing to shield batteries from pressure fluctuations; perform regular pre-flight checks.	Very Low	Very Low

1. **Vibrations during the Parabolic Flight**
    - **Risk**: Vibrations experienced during parabolic flight may cause misalignment of the experimental apparatus or compromise the sensitive equipment used for data collection, particularly the high-resolution cameras.
    - **Mitigation Strategy**: To minimize the impact of vibrations, the experimental equipment will be securely fastened using Velcro strips and specialized mounting brackets to reduce movement. Additionally, team members will handle the equipment with extreme care during setup and removal, ensuring that all components remain properly aligned and functional throughout the flight. In case any misalignment is detected during the intervals between microgravity phases, adjustments will be made immediately to maintain accuracy in data collection.
2. **Hypogravity Effects on Tampon Saturation**
    - **Risk**: During the hypogravity phases of the flight, there is a risk that the tampons may not saturate fully or uniformly with the synthetic fluid, potentially impacting the subsequent microgravity trials and the accuracy of droplet dispersion observations.
    - **Mitigation Strategy**: This risk will be carefully monitored and considered during post-flight mass analysis of the tampons to ensure accurate measurement of fluid retention. Furthermore, the use of a speculum to close the syngina during the experiment will help prevent the synthetic fluid from leaking, thereby controlling for unintended saturation discrepancies. This controlled closure will allow us to minimize the potential effects of 2g on fluid retention.
3. **Pressure Effects on Battery Selection**
    - **Risk**: The fluctuating pressure conditions inside the aircraft could affect the performance or safety of the batteries powering our equipment.
    - **Mitigation Strategy**: The risk posed by pressure changes is considered low, as the batteries will be contained within a plastic housing unit designed to minimize any potential damage from environmental factors. The plastic casing will serve as a protective barrier, ensuring the batteries remain functional and shielded from pressure fluctuations. Regular pre-flight checks will also be conducted to ensure that the batteries are fully operational and safely secured.

By addressing these risks and implementing effective mitigation strategies, we aim to ensure the successful execution of our experiment, maintaining the integrity of the data collected and safeguarding our equipment from environmental impacts throughout the parabolic flight.

3.3 In-flight Operations

The mission specialists will perform the following procedure to efficiently and accurately capture data for the droplet formation upon removing the tampon, while maximizing the number of trials recorded during the parabolic flight sequence. The team of four mission specialists will split up into pairs of two. Each pair will perform the experiment procedures on their respective experimental model, therefore a total of two experimental models will be used to maximize the amount of data collected during the flight sequence.

(1) Level Flight Prior to the Parabola

During the first regime of level flight, one mission specialist from each pair will insert their hands into the glove interface of the model. They will then remove a saturated tampon from its container, use the speculum to widen the synthetic vaginal model and place the saturated tampon inside the vaginal model. They will then close the lid of the open container and fix the speculum onto the wall of the experimental model.

(2) First 2G Pull

During the first 2G pull, one member will monitor and ensure the camera is recording while the member using the glove interface prepares for the microgravity period.

(3) Microgravity

In microgravity, the tampon will be removed from the synthetic model by smoothly pulling on the tampon string and then will be held by its string in the camera's view. When there are 5 seconds before the second 2G pull, the tampon will be placed back in its original lidded container.

(4) Second 2G Pull

During the second 2G pull any residual droplets will fall onto the white paper lining the box of the experimental model. In the next level flight period, any residual synthetic blood on the outside of the vaginal model will be carefully wiped down with a cloth and the paper liner will be collected and replaced in preparation for the next trial.

Due to the experiment requiring preparation during level flight time between each trial, the ideal flight sequence would be 12 individual parabolic maneuvers during the 60-minute flight time. This would give the mission specialists approximately three and a half minutes for preparation in level flight between trials. The 12 parabolic maneuvers would allow data collection from 3 trials per tampon brand from each experiment model for a total of 24 tampons tested.

4.0 Project Plan

4.1 Funding Strategy

This project will be seeking funding from three prominent sources, UBC Okanagan's Tuum Est Student Initiative Fund, the School of Engineering Professional Activity Fund (PAF), and the Engineers and Geoscientists British Columbia (EGBC) Student Team funding.

Table 5: Summary of Funding Strategy

Funding Source	Maximum Funding	Eligibility Criteria	Application Deadline	Decision Timeline	Notes
1. UBC Okanagan's Tuum Est Student Initiative Fund	Up to $3,500	All team members must be UBC Okanagan students; the project must support student outcomes.	Ongoing (except December & August)	Within 1 week after submission	No restrictions on fund use that affect the project; pursuing other funds is favourable for the application.
2. School of Engineering Professional Activity Fund (PAF)	No specified maximum	All students must be enrolled in an undergraduate engineering program and in good standing.	Friday, February 21, 2025	March 7, 2025	Itemized expense report required; iterative approval process.
3. EGBC Student Team Funding	Based on submitted budget	At least one EGBC student member; team must be BC-based.	Friday, April 12, 2024	Not specified	Historically funds SEDS design challenges like CAN-SBX 2024.

1. **UBC Okanagan's Tuum Est Student Initiative Fund**

This fund aims to fund a variety of student-led initiatives with a maximum funding reaching $3500 per initiative. This fund's eligibility criteria requires that all members participating for this initiative to be UBC students from the Okanagan campus, a criteria that is valid for all of Space MENs team members. This source of funding doesn't introduce any prohibitory restrictions for use within this project.

In order to receive this funding, Space MENs must demonstrate that this project supports student development and learning experiences. Due to several team member's ongoing relationship with Tuum Est funding for other extracurricular projects, it is expected that funding for Space MENs will be viewed favorably.

The deadline for this fund is tentative, and it accepts applications every month of the year except for December and August. The decision process is swift and we would expect a response within 1 business week.

2. **School of Engineering Professional Activities Fund (PAF)**

PAF funding focuses on supporting undergraduate professional development. There is no maximum funding allowance for student projects as dictated by the fund's policy. This funding application requires all students to be enrolled in the engineering undergraduate program and hold good standing, which is valid to all our members.

The deadline for this fund is Friday, February 21, 2025. Decisions will be communicated by March 7, 2025.

3. **Engineers and Geoscientists British Columbia (EGBC) Student Team Funding**

EGBC Student Team funding requires that at least one student is an EGBC student member, of which we have a few members already registered as part of the organization. It also requires that our team originates from a BC based team. It requires submitting an itemized budget and we can request an amount based on our submitted budget.

The deadline for this application is Friday, April 12, 2024. This funding source has historically funded other SEDS design challenges, specifically CAN-SBX 2024. This gives us confidence in its approval.

Regarding the status of each of these funding sources, we have yet to acquire approval for the CAN-RGX competition before we can apply. There is at least a 2 months float between the earliest application deadline and the expected approval date for CAN-RGX.

4.2 Outreach Strategy

Our team has planned a series of outreach events aimed at engaging diverse audiences, including the general public, K-12 students, and the academic community. These events will extend beyond the duration of the flight campaign, ensuring long-term engagement with various groups. Below are the key outreach events, along with specific details on the target audience, persons responsible, and measurable outcomes for each event:

Table 6: Outreach Strategy Summary

Event Name	Target Audience	Date(s)	Person Responsible	Measurable Outcomes
WISEST Summer Research Program Presentation	Grade 11 girls in STEM	June – August 2025 (exact date TBD)	Yosamin Esanullah	Number of student attendees; post-event feedback surveys measuring engagement and interest in aerospace and STEM.
UBC Okanagan WiSE Seminar	University women in STEM	Term 2, 2025 (date TBD)	Angela Pepito	Number of seminar attendees; feedback on learning outcomes related to space science and project-specific insights.
UBC Geering Up Saturday Club	K-12 students (Grades 1-10)	January 18, 2025 – March 29, 2025	Brody Bird	Number of students participating; assessment of learning outcomes through post-workshop quizzes or surveys.

1. WISEST Summer Research Program Presentation

The WISEST Summer Research Program offers Grade 11 girls from across Canada the opportunity to conduct research at the University of Alberta. Our team will present our project during the summer program, aiming to inspire young women to pursue careers in science and engineering, particularly in aerospace and space research. Yosamin Esanullah, who has participated in this program, will leverage her network to organize and lead this event. All teammates are welcome to participate.

2. UBC Okanagan Women in Science and Engineering (WiSE) Seminar

WiSE aims to empower young women in science and engineering as they transition from undergraduate education to professional careers. Our team will present a professional seminar during Term 2 of 2025, discussing our project and its importance to aerospace research. This event will primarily be led by Angela Pepito, with support from the entire group. We will use feedback forms to assess participants' understanding of the project and its relevance to their studies.

3. UBC Geering Up Saturday Club Fluid Dynamics Workshop

Geering Up is a popular program at UBC Okanagan that runs hands-on STEM workshops for K-12 students on Saturdays. From January to March 2025, we will host a fluid dynamics workshop focused on teaching students about microgravity and fluid mechanics, using engaging, age-appropriate activities. Brody Bird will lead this workshop, with support from the team. Learning outcomes will be measured using post-workshop quizzes or surveys, allowing us to gauge students' understanding of the concepts presented.

These outreach activities will help us engage a wide range of audiences and inspire the next generation of engineers, scientists, and astronauts, while also ensuring that our work reaches academic and public communities alike.

Appendix A: References

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