CAN-SBX Proposal Guidelines
2017-2018

1.0 Project Scope

The Canadian Stratospheric Balloon Experiment Design Challenge (CAN-SBX) is a competition for Canadian post-secondary students to design, build and test a small scientific experiment to be flown on board the CARMEN CITA, a stratospheric balloon gondola. This gondola, owned and operated by the Centre national d'études spatiales (CNES), is capable of lifting 250-600 kilograms 30-35 kilometers in the air. This year, the Canadian Space Agency (CSA) and CNES are partnering on a campaign involving two gondolas, one of which will carry a number of Canadian payloads, including the two selected CAN-SBX experiments. Undergraduate students from Canadian universities across Canada will be challenged to submit a proposal outlining a payload design in accordance with constraints determined by SEDS-Canada and the CSA. The two experiments selected by judges will be evaluated on several criteria including feasibility of the design, relevance to Canadian stratospheric science, the project's team management structure and the teams' outreach plan. Any student team from a post-secondary academic institution can submit a proposal for their experiment, however only two will have the opportunity to build and test their experiment. Team members from each team may also receive a travel grant to join the stratospheric balloon campaign in Timmins, Ontario in August 2018. These students will be responsible for overseeing the execution of their experiment.

SEDS-Canada and its collaborators developed this initiative to benefit students who are passionate about space exploration by providing them access to a platform to do ground-breaking research in the stratosphere. CAN-SBX trains students to complete a full engineering design cycle from conception to execution. This is a valuable opportunity to gain transferable professional skills applicable to careers in STEM. Student teams will gain exposure to project management and risk mitigation which are essential components of many projects in the space industry. In addition, they will have the opportunity to work with Subject Matter Experts who will coach and mentor them throughout the competition as well as the opportunity to participate in an international campaign involving several space agencies.

2.0 Eligibility

All undergraduate students enrolled at recognized post-secondary institutions in Canada are eligible to enter this competition. Students will be required to provide proof of enrolment at the time of submission of the Letter of Intent. Graduate students such as those enrolled in Masters, PhD and Post-Doc programs cannot form a team but may join undergraduate teams as advisors.

3.0 Team Guidelines

3.1 Primary Institution

The Primary Institution is a recognized college or university in Canada where the team leader is enrolled as a student.

3.2 Collaborating Institutions

Collaborating institutions are colleges, universities and high schools who have contributed time and/or resources to the project.

3.3 Team Leader

The team leader is responsible for organizing and coordinating the efforts of the entire team for the duration of the project. Duties and tasks may vary depending on the size and composition of the team, however the one requirement for the team leader is that they be enrolled at the team's primary institution.

3.4 Team Size

There are no constraints for team size however it is recommended that a team be composed of at least 6 students.

3.5 Faculty Advisor(s)

Teams must enlist one faculty member from their primary institution to act as their team's advisor. These faculty members must complete a Faculty Letter of Endorsement (Template can be found here: http://seds.ca/projects under the CAN-SBX tab which is submitted with the Letter of Intent. Teams may have additional faculty advisors (from the primary or any collaborating institutions) as needed. The faculty advisor(s) is required to attend progress meetings via teleconference. It should be noted that faculty advisors cannot become SMEs or project reviewers/judges for the competition.

3.6 Funding Expectations

Selected teams will be encouraged to apply for a FAST grant to cover the cost of travel from their primary institution to Timmins Ontario and food/accommodations. The grant may also cover the experiment's shipping expenses to and from Timmins. The maximum grant value is $30,000CAD. For the grant to be disbursed, the team's faculty advisor must submit an application to the CSA outlining the expected expenses (details of the application process TBD). All other expenses incurred during the development of the experiment, such as building materials and access to tools and lab space, are expected to be covered by the team. Teams are encouraged to acquire funds for their project through fundraising campaigns, college/university grants, and government grants.

4.0 Formatting Guidelines for Submission of Documents

- Only electronic copies will be accepted
- Standard 8 ½" x 11" pages
- 1" margins on the top, bottom and sides
- 12 point Times New Roman font
- Numbered pages on the bottom right corner

5.0 Constraints

In order for reviewers to assess the project proposal, the design **must**:

1. Be contained within a Pelican case shown in Figure 1 (35.9 x 33.5 x 25.1 cm)
2. Weigh no more than 8 kg (not including the Pelican case)
3. Constrain its peak power consumption below 30Wh using a 5 Amp line. Power will be supplied by the CSA power supply.
4. Be suited for the CARMEN gondola shown in Figure 2.
5. SEDS payloads, without transmitting TC/TM, may be plugged in the CSA telemetry system and get time-stamping, GPS location, Real-Time Clock and record data everything onboard. No telemetry transmission instrumentation will be provided.

5.1 Pelican case

All experiments must be designed to fit into a hard-shell case to ensure the safety of the experiment as well as the gondola. The case is a Pelican product (Pelican Storm iM2275) which will be supplied to the two selected teams by the CSA. The inner dimensions of the case are 35.9 x 33.5 x 25.1 cm. Further details can be found on the Pelican website.

Figure 1 – Pelican case for the CAN-SBX experiment

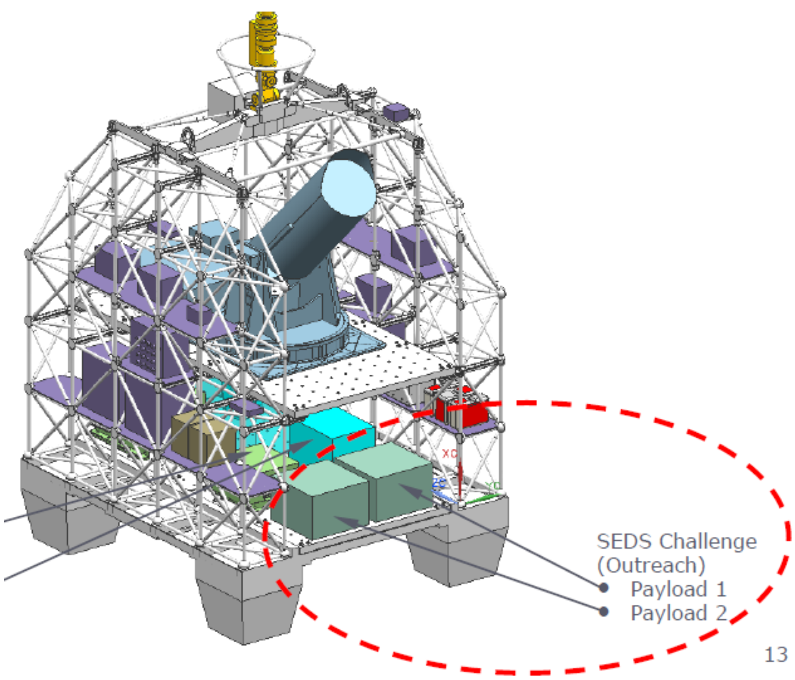


Figure 2 – CARMEN Gondola

6.0 Proposal

6.1 Overview

The project proposal is the first of four technical documents that must be submitted for a team to advance through the STRATO Science 2018 Campaign. This document will be judged by a panel of SMEs with experience in the field of stratospheric research using balloons and should be written with this audience in mind. Your document must be limited to 20 pages, including appendices. Please read all the requirements to ensure your proposal is reviewed.

NOTE: Proposals which do not meet the experimental constraints outlined in section 5.0 will not be reviewed.

6.2 Submission Deadline

December 1st 2017, 11:59 PM EDT

6.3 Proposal Guidelines

In the order listed below, your project proposal should include the following sections:

1) Cover page

The cover page should include all the necessary information about your team and project:

- Project title
- Team name
- Team member names and academic affiliation
- Date of submission
- Team logo (optional)

2) Table of contents
3) List of tables and figures

This will serve as a directory for figures and tables included in the document. Provide page numbers or refer to the appendix for each item.

4) Executive summary

The executive summary should provide an overview of all the sections in the proposal in **one** page or less. It should only include information that can otherwise be found in the body of the proposal:

- Brief introduction of the project
- Experimental design requirements met

- Scientific value
- Abbreviated budget and timeline
- Outline of outreach activities planned
- Conclusion and expected outcomes

5) Proposal Plan

   Following the marking scheme provided in Section 7.0, address all proposal criteria in full sentences, using primary research literature and diagrams when necessary. References should be cited in IEEE style and a bibliography should be provided before the appendix. Diagrams may be included in the body of the text if they are small or in the appendix section if they are full-page. All diagrams must include a descriptive legend or caption. Follow the templates provided in the appendix to complete the Risk Assessment Tables for technical and managerial risks, the Work Breakdown Structure, and the Budget and Funding Table.

6) References

   Following IEEE style, provide a list of references cited in your proposal.

7) Appendix

   The appendix should be used for full-page diagrams, engineering drawings, and any other documents which are referenced in your proposal. List appendices using capital letters (i.e., Appendix A, B, C, etc.)

7.0 Proposal Review Criteria

Each submitted proposal will be evaluated and scored according to a standardized rubric for the following criteria (weight in brackets):

Description of Criteria	Marking Scheme
Scientific/Technological merit (35%)	
Scientific/technological Objectives	
Describe the scientific/technological objectives and the expected outcomes of the proposed experiment (e.g., what are your hypotheses and how will you test them?).	0 = no objectives provided, or, objectives are inadequately defined, or not aligned with purpose of competition 1 = objectives are aligned with purpose of competition 2 = the objectives are well aligned with the purpose of the competition and have a high likelihood of delivering on the stated outcomes
Novelty	
Have similar experiments been conducted in the past? If so, describe how the proposed experiment is different/original.	0 = an experiment with major similarities has been conducted in the past 1 = some literature research was conducted 2 = in-depth literature research is provided leading to the conclusion that the experiment is novel

Relevance of the high altitude environment	
Describe why the project requires stratospheric altitudes/environment to achieve its scientific/technological objectives. Show that the scientific/technological objectives can be achieved within the flight profile of the balloon	0 = the experiment was not designed for a high altitude environment1 = reasoning for conducting the experiment in a high altitude environment is described but details not elaborated on how experiment will survive a high altitude environment 2 = the experiment is appropriate for up to a high altitude environment
Bonus: Importance to Canada's space sector	
Referring to the Canadian Space Agency's 2017-18 Report on Plans and Priorities — Sub and Sub-Sub Programs, describe how the proposed project fits within Canada's current key strategy areas related to space science/technology.	2 bonus marks will be given for an appropriate and well-described evaluation of the proposal's relevance to at least one key strategy area (referred to as 'sub-sub programs' in the document)

Technical description and feasibility (35%)	
Experimental Design	
Describe how the experiment satisfies each of the CAN-SBX experimental constraints (refer to Section 5.0). Use diagrams and/or sketches to illustrate how the experiment satisfies these constraints.	Pass/Fail* *Only projects satisfying all experimental constraints will be reviewed.
Describe what you intend to measure (variables) and the data collection methods involved.	0 = proposed variables or data collection methods are inappropriate/inadequate 1 = proposed variables and data collection methods are reasonable but lacking in detail 2 = proposed variables and data collection methods are achievable and well-described

Using the templates in the appendix, complete a table listing component (a) names (b) descriptions, (c) quantities, (d) estimated power budget (in Watts) and estimated mass budget (in Kgs) of all components of the design (e.g., mechanical and electrical parts). Specify if a component has moving parts. Include estimated total power consumption and mass (with and without a 15% margin).	0 = a table not provided or inappropriate/ incompatible for high altitude flight 1 = table is lacking detail in its description of components or power and mass budgets 2 = thorough descriptions of all components are provided and components are appropriate
Explain how the stratospheric environment (pressure, vibration, temperature, radiation, etc) will affect the proposed experiment.	0 = no detailed description for any of the variables provided, or the effects of at least one variable is inappropriate/hazardous 1 = a description for each variable is provided but lacking details or appropriate assessment 2 = a detailed description for each variable is provided and no risks are expected
List all components of your experiment classified as hazards under Canada's Hazardous Products Act and specify each hazard. Refer to Appendix A	0 = no hazards were specified 1 = some hazards are missing or were not specified according to Canada's Hazardous Products Act and Appendix A 2 = all hazards were identified and specified according to Canada's Hazardous Products Act and Appendix A
Experimental Procedures	
Describe pre-flight, in-flight and post-flight procedures for proper execution of the experiment. Specify how any moving parts will function throughout these procedures. Include diagrams and/or sketches as needed.	0 = descriptions not provided or inappropriate 1 = descriptions are incomplete or lacking detail 2 = descriptions are well-described for each stage and are appropriate for the balloon's flight profile

Resources	
Describe the specialized facilities or tools/equipment needed and how the team intends to gain access to these to design, build and test the experiment (e.g., CAD software, laboratory facilities, custom-machined parts).	0 = the resources needed are inappropriate/inadequate 1 = the resources are listed but details not provided 2 = the resources are well-defined and achievable
Technical Risk Assessment	
Describe risks involved to team members during the building/assembly of the experiment and how these risks will be handled (will team need to be trained to use tools/equipment, etc.). Special attention should be given to risks involving hazardous products. Refer to Template in Appendix B.	0 = the risks are not described or inappropriate/avoidable 1 = the risks are defined but mitigation strategies are not 2 = the risks and mitigation strategies are well-defined and unavoidable
Describe the risks to team members when executing any tasks during pre-launch and post-flight procedures such as experiment setup and retrieval. Provide mitigation strategies to eliminate (or minimize) risks. Refer to Template in Appendix B.	0 = the risks are not described or inappropriate/avoidable 1 = the risks are defined but mitigation strategies are not 2 = the risks are minimal; mitigation strategies are well-defined and unavoidable
b. Technical & Environmental	
Describe any points of failure for the experiment, such as mechanical malfunctions, leaks, etc.	0 = points of failure were not described or are inappropriate for the experimental design 1 = points of failure inadequately described 2 = all possible points of failure have been described in sufficient detail
Describe the safety mechanisms (ex: kill switches) that will be integrated into the experiment (providing technical drawings/diagrams is encouraged) and how they will be initiated.	0 = no safety mechanisms included 1 = inadequate safety mechanisms or description is lacking detail 2 = well-defined, adequate safety mechanisms which are easily initiated

Project Plan (15%)	
Team Structure and Management	
Following the template provided (see Appendix C, Work Breakdown Structure), assign roles and tasks for each team member, including high school students and faculty advisors. You may rearrange or add components to the template to suit your project and team size.	0 = the roles of each member are unclear/poorly defined 1 = the roles of each member are defined but lacking detail 2 = the roles of each member are defined in detail for each stage of the project
Demonstrate that team members have a variety of backgrounds. Teams should strive to have discipline diversification throughout their teams (i.e. both scientists and engineers)	0 = no discipline diversity presented 1 = team has some discipline diversity 2 = team has a diverse range of disciplines
If a team member chooses not to continue with the project, describe the protocol for re-organizing the division of labour.	0 = no strategies provided 1 = a strategy is provided but lacking details 2 = a well-defined strategy is described
Project Timeline	
In a table, diagram or Gantt chart, present an expected timeline of the project's development. Include details such as length of time required for building and testing of each sub-system of the experiment, and completion dates of deliverables such as the PDR, CDR and Balloon Experiment Safety Data Package.	0 = a timeline is not provided 1 = the timeline is inappropriate or lacking details 2 = the timeline is complete and well-defined
Describe how the team intends to stay on schedule and provide strategies that would be implemented when the project is behind schedule including the role of each key team member.	0 = no plan provided or the plan is insufficient 1 = some mitigation strategies but no detailed plan provided 2 = details about which team members will lead the scheduling efforts and how each key team member will contribute to staying on schedule were provided

Budget and Funding	
Following the template provided (see Appendix D, Budget and Funding) include all foreseeable expenses for the entire duration of the project including travel and food, purchase and fabrication of equipment/parts, etc. Describe current and future sources of funding including the duration and amount of this funding	0 = budget and funding plan not provided or inappropriate 1 = budget and funding plan not elaborated in detail 2 = budget and funding plan is achievable and well-described
Describe the measures the team will take to ensure the project stays within budget and how the team intends to acquire the necessary funds. Explain the role of each key team member.	0 = the team has not made a plan to stay within budget or the plan is insufficient 1 = the team has listed some measures for staying within budget but no detailed plan provided 2 = the team has provided details about which team members will lead the budgeting efforts and how each key member will contribute to staying within budget
Managerial Risk Assessment	
Create preliminary risk tables based on the template provided (see Appendix B). Evaluate each risk based on its probability and its consequences. Provide brief justifications for your assessments.	0 = tables not provided or inappropriate 1 = tables are incomplete or lacking detail 2 = tables are well-elaborated and the level of detail is sufficient. Risks have been justified based on sound reasoning

Outreach (15%)	
Public	
Describe how the team intends to engage with the public	0 = the team has not made an

and K-12 students for each stage of the project, including after the campaign.	engagement plan or the plan is inappropriate for this project 1 = the team has listed some methods for engagement but has not elaborated on details or some aspects of the plan are missing 2 = a detailed plan for engagement throughout the duration of the project is provided
Describe a plan for the involvement of high school students in the project.	0 = the team has either chosen not to pursue the inclusion of high school students or a plan for recruiting from high schools was not provided 1 = the team intends to recruit high school students but a plan to achieve this has not been elaborated in enough detail 2 = the team intends to involve high school students in the project and they have a descriptive plan for the contributions these students will provide
Academic	
Describe how this project will benefit the scientific community (publications, seminars, etc.).	0 = the team has not provided any information on the project's impact on the scientific community 1 = Benefits are listed but details are not provided 2 = the team has elaborated on the project's impact on the scientific community and given specific examples of how the scientific community will benefit
Describe how this project will increase interest and retention of talent in space exploration and development in Canada and how it will inspire and encourage youth to pursue studies in STEM fields.	0 = the project will not increase interest and retention of talent or no adequate description was provided 1 = the description is lacking detail

2 = the project's rationale for increasing interest and retention of talent is appropriate and well-described.

Appendix A - Physical and Health Hazards

Physical Hazards

Hazard Class	General Description
Flammable gases Flammable aerosols Flammable liquids Flammable solids	These four classes cover products that have the ability to ignite (catch fire) easily and the main hazards are fire or explosion.
Oxidizing gases Oxidizing liquids Oxidizing solids	These three classes cover oxidizers, which may cause or intensify a fire or cause a fire or explosion.
Gases under pressure	This class includes compressed gases, liquefied gases, dissolved gases and refrigerated liquefied gases. Compressed gases, liquefied gases and dissolved gases are hazardous because of the high pressure inside the cylinder or container. The cylinder or container may explode if heated. Refrigerated liquefied gases are very cold and can cause severe cold (cryogenic) burns or injury.
Self-reactive substances and mixtures	These products may react on their own to cause a fire or explosion, or may cause a fire or explosion if heated.
Pyrophoric liquids Pyrophoric solids Pyrophoric gases	These products can catch fire very quickly (spontaneously) if exposed to air.
Self-heating substances and mixtures	These products may catch fire if exposed to air. These products differ from pyrophoric liquids or solids in that they will ignite only after a longer period of time or when in large amounts.
Substances and mixtures which, in contact with water, emit	As the class name suggests, these products react with water to release flammable gases. In some cases, the flammable gases may ignite very quickly (spontaneously).

flammable gases	
Organic peroxides	These products may cause a fire or explosion if heated.
Corrosive to metals	These products may be corrosive (chemically damage or destroy) to metals.
Combustible dust	This class is used to warn of products that are finely divided solid particles. If dispersed in air, the particles may catch fire or explode if ignited.
Simple asphyxiants	These products are gases that may displace oxygen in air and cause rapid suffocation.
Physical hazards not otherwise classified	This class is meant to cover any physical hazards that are not covered in any other physical hazard class. These hazards must have the characteristic of occurring by chemical reaction and result in the serious injury or death of a person at the time the reaction occurs.If a product is classified in this class, the hazard statement on the label and SDS will describe the nature of the hazard.

Health Hazards

Hazard Class	**General Description**
Acute toxicity	These products are fatal, toxic or harmful if inhaled, following skin contact, or if swallowed. Acute toxicity refers to effects occurring following skin contact or ingestion exposure to a single dose, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours. Acute toxicity could result from exposure to the product itself, or to a product that, upon contact with water, releases a gaseous substance that is able to cause acute toxicity.
Skin corrosion/irritation	This class covers products that cause severe skin burns (i.e., corrosion) and products that cause skin irritation.
Serious eye damage/eye irritation	This class covers products that cause serious eye damage (i.e., corrosion) and products that eye irritation.
Respiratory or skin sensitization	A respiratory sensitizer is a product that may cause allergy or asthma symptoms or breathing difficulties if inhaled. Skin sensitizer is a product that may cause an allergic skin reaction.
Germ cell mutagenicity	This hazard class includes products that may cause or are suspected of causing genetic defects (permanent changes (mutations) to body cells

	that can be passed on to future generations).
Carcinogenicity	This hazard class includes products that may cause or are suspected of causing cancer.
Reproductive toxicity	This hazard class includes products that may damage or are suspected of damaging fertility or the unborn child (baby). Note: There is an additional category which includes products that may cause harm to breast-fed children.
Specific target organ toxicity – single exposure	This hazard class covers products that cause or may cause damage to organs (e.g., liver, kidneys, or blood) following a single exposure. This class also includes a category for products that cause respiratory irritation or drowsiness or dizziness.
Specific target organ toxicity – repeated exposure	This hazard class covers products that cause or may cause damage to organs (e.g., liver, kidneys, or blood) following prolonged or repeated exposure.
Aspiration hazard	This hazard class is for products that may be fatal if they are swallowed and enter the airways.
Biohazardous infectious materials	These materials are microorganisms, nucleic acids or proteins that cause or is a probable cause of infection, with or without toxicity, in humans or animals.
Health hazards not otherwise classified	This class covers products that are not included in any other health hazard class. These hazards have the characteristic of occurring following acute or repeated exposure and have an adverse effect on the health of a person exposed to it - including an injury or resulting in the death of that person. If a product is classified in this class, the hazard statement will describe the nature of the hazard.

Appendix B – Risk

Create a risk table for each technical risk (TR#) and management risk (MR#), describing what the risk is, its probability and consequence with associated rankings (Low, Medium or High), and a mitigation and contingency plan.

List all risks (TR1, MR1, etc.) in the Risk Assessment Matrix (Table 2).

Table 1. Risk Table

Risk Event – TR1	**What is the risk?**	
Probability	L / M / H	Describe probability
Consequence	L / M / H	Describe consequence
Mitigation Plan	Describe plan to mitigate risk	
Contingency Plan	Describe plan in case risk occurs	

Table 2. Risk Assessment Matrix

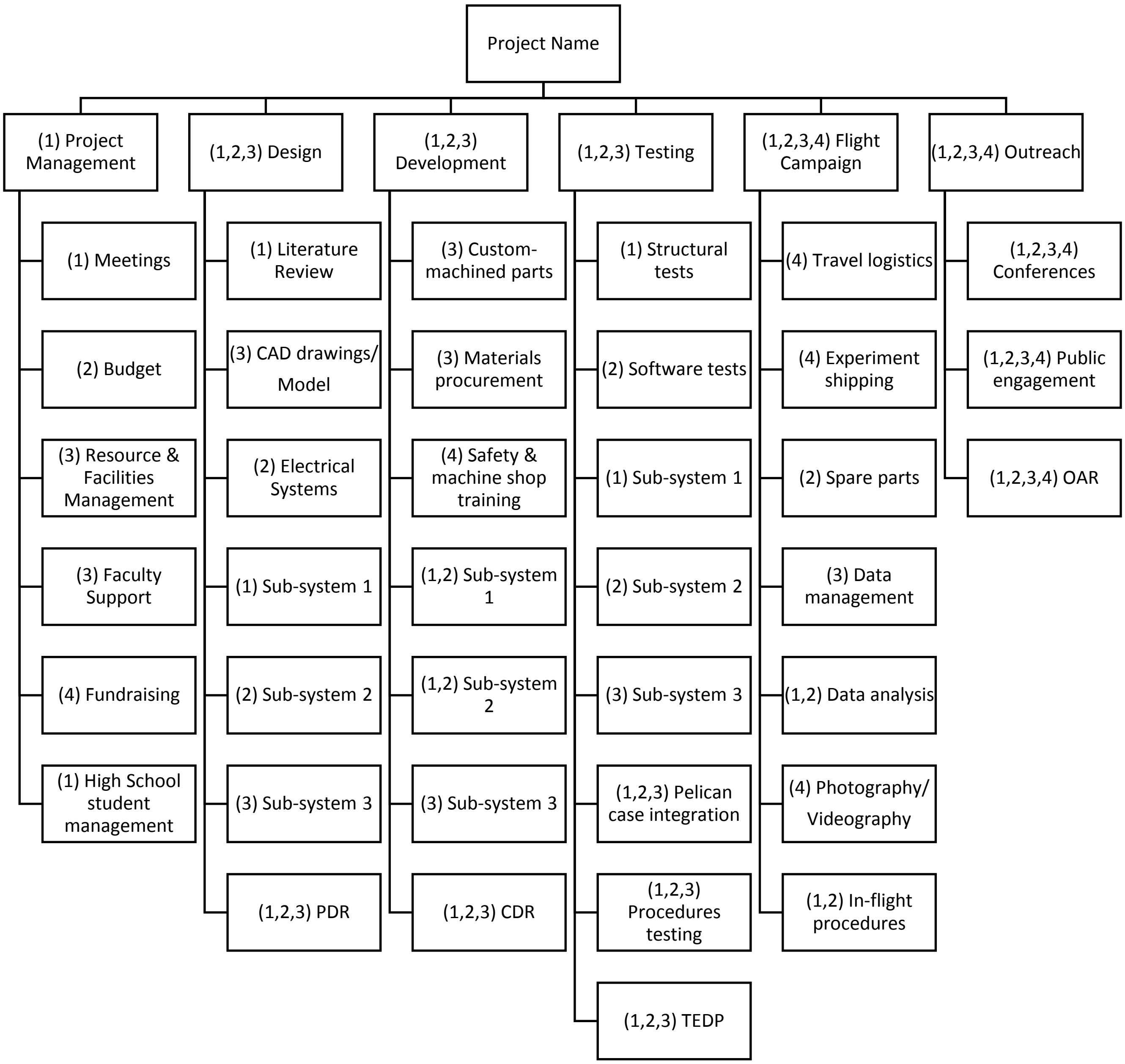
		Probability		
		Low	Medium	High
Consequence	Low			
	Medium			

	High			

Appendix C - Work Breakdown Structure

The work breakdown should follow (but should not be limited to) the general scheme outlined below and should comprise your entire project from start to finish. Add or remove tasks as needed based on your project and management plan. Assign a number to each member of your team and list their names in the legend. Each task in the WBS should be given a number(s) corresponding to the team members responsible for that task.

Example on the following page.



Legend: (1)=Student 1 name, (2)=Student 2 name, (3)=Student 3 name, (4)=Student 4 name

Appendix D - Budget and Funding

Using your Work Breakdown Structure as a guide, complete a table listing the costs of each major task of the project. Include all current and future sources of funding in order to estimate total available funds and determine the overall project budget. Include as many details as possible.

Budget and Funding Plan					
Estimated Expenses					
	Project Tasks	Labour Cost ($)	Material Cost ($)	Travel Cost ($)	Other Costs ($)
Project Management	Meetings				
	Resource & Facilities Management				
	High school student management				
	Fundraising				
	Subtotal				
Design	CAD drawings/Model				
	Prototype				
	Electrical systems				
	Sub-system 1				
	Sub-system 2				
	Sub-system 3				
	Subtotal				
Development	Custom-machined parts				
	Materials and Tools				
	Machine shop training				
	Sub-system 1				
	Sub-system 2				

	Sub-system 3				
	Subtotal				
Testing	Structural tests				
	Software tests				
	Sub-system 1				
	Sub-system 2				
	Sub-system 3				
	Pelican case integration				
	Procedures testing				
	Subtotal				
Flight Campaign	Travel to/from FRL				
	Meals				
	Experiment shipping				
	Spare parts				
	Data collection and management				
	Data analysis				
	Photography/videography				
	In-flight procedures				
	Subtotal				
Outreach	Conferences				
	Public engagement				
	Subtotal				
Other Costs	Other costs				
	Other costs				
	Other costs				
	Subtotal				
Subtotals					

Subtotal With 15% Margin				
Total (Estimated)				

Estimated Funding		
		Value ($)
Funding Sources	University/College Grants	
	Government Grants	
	Corporate Sponsorships	
	Fundraising Campaigns	
	Other	
Subtotal		
Subtotal with 15% Margin		
Total (Estimated)		