GUIDELINES FOR WRITING THE

EXPERIMENT SAFETY EVALUATION
(FLIGHT AND GROUND OPERATIONS)

NASA REDUCED GRAVITY STUDENT FLIGHT PROGRAM 2006

SAFETY EVALUATION OF AN EXPERIMENT

This document explains how to write a comprehensive Safety Evaluation of an experiment for inclusion in the team's proposal. The information provided will be used by the Reduced Gravity Office to confirm that each team's experiment is safe to handle on the ground and to fly in the airborne environment of the reduced gravity aircraft. Each team's proposal should describe its plan to design, fabricate and operate the proposed experiment in a safe manner.

The Reduced Gravity Office gives final approval to all experiments that are proposed for flight as part of the NASA Reduced Gravity Student Flight Program. Any experiment deemed unsafe by RGO reviewers will NOT be allowed to fly. Usually, experiments considered unsafe for flight have poorly designed (or non-existent) hazard controls or are simply too volatile to enclose in the pressurized aircraft cabin. Potential reasons for disqualification include (but are not limited to) any of the following:

. •Dangerously high temperatures or pressures that are not properly contained
. •Irresponsible use of toxic, corrosive, explosive, flammable or other hazardous materials
. •Poorly guarded mechanical parts in motion
. •Use of sharp objects without proper containment or shielding
. •Use of any device with sufficient probability to damage or disrupt ground or aircraft systems
. •Hazardous/Impractical experiment designs (such as structural or electrical designs)

Keep in mind that experiments that are safe in a one-g environment are not necessarily safe in a zero-g environment. For example, a chemical experiment that is easy to contain at the team's lab bench at school is very difficult to contain in micro-gravity. A drop of acid will fall to the floor in one-g in the school's laboratory; however, in zero-g that same drop will end up floating at eye level and could be inhaled into the lungs!

When writing the proposal, the team should be sure to cover each of the safety items listed below. Do not, under any circumstances, leave a topic area blank. In some cases the safety topic may not apply to your experiment. That’s okay; just include an explanation of why the safety topic is irrelevant. For example, an experiment that does not contain a laser device should include the statement: “No lasers contained in this experiment,” for the Laser Systems portion of the proposal.

In some cases, detailed information about the experiment may not yet be available. That’s okay too! This is an experiment *proposal*. RGO reviewers understand that student researchers may not have “bent metal” or assembled experiment hardware at the time the proposal is submitted. As long as the minimum amount of information is provided for the experiment (as required in the following safety item list), the remaining details may be provided later in the Test Equipment Data Package (TEDP). In this case, the team should provide the following statement: “this data will be included in the formal TEDP submitted after the proposal has been accepted.” NOTE: It may be to the team’s advantage to provide as much preliminary information as possible so as to resolve possible safety questions in the minds of the reviewers. If the hardware is already available and the team is able to complete any of the topic areas, then please go ahead and do so.

Address each of the following items in the Safety Evaluation section of your proposal. Be sure to organize this section of the written proposal in the same item-order displayed below.

Flight Manifest	Provide a list of names of all the proposed flyers. This includes: the four primary flyers and one alternate flyer. State whether or not any of the proposed flyers have prior flying and/or ground crew experience with the RGSFOP and include dates of any previous program participation.
Experiment Description / Background	Briefly describe what the team is researching. Explain how the team intends to accomplish the research objective, whether or not the proposed experiment has flown prior to the current program, and, if a re-flight, how has the experiment or objectives have been changed to justify flying the experiment again.
Equipment Description	Provide a brief description of how the team intends the experiment to operate; how ground and flight components are proposed for use, and provide schematics and/or pictures of the proposed hardware. Any other information that can be provided at this time to better describe the proposed ground and flight equipment is highly recommended. The more information provided, the better the chance of addressing Reduced Gravity Office safety concerns.
Structural Design	Provide a brief description of the materials used for the structural hardware and explain how this material will be implemented in a frame designed to withstand the expected structural loads. Explain how components will be attached to the experiment's frame and how the frame will be attached to the aircraft floor (i.e. bolts, studs, and/or cargo straps). Schematics and/or pictures of proposed hardware are helpful.
Electrical System	Provide a brief description of the electrical components proposed for both ground and flight operations. Explain how the components will be used and what type of electrical power will be needed on the ground, and/or during flight. List all voltages, frequencies, and electrical currents expected in the design. Schematics and/or pictures of the electrical system are helpful.
Pressure / Vacuum System	Provide a brief description of any pressure/vacuum systems incorporated in the operation of the experiment. Briefly describe its components and how they will operate. Describe the fluid/gas to be pressurized and list the quantity that will be used. Provide information on the proposed operating pressure values and describe any pressure relief strategies to be implemented in the pressure system design.
Laser System	Provide a brief description of the type, class, and function of any laser proposed for flight on the reduced gravity aircraft. Address any controls incorporated with the use of the laser to ensure its safe operation.
Crew Assistance Requirements	Provide a brief description of any special duties that will be requested of the Flight Crew in assisting with the operation of the team's experiment on the ground and/or in-flight.
Institutional Review Board (IRB)	Any experiment involving human test subjects, animal test subjects, and/or biological substances will not be accepted for this program.
Hazard Analysis	Address any and all hazards associated with the operation of the proposed experiment. Describe, in detail, what could go wrong (however unlikely); how it could go wrong (however unlikely); the repercussions of such an incident if it should occur; and what controls have been included in the experiment's operation/design to ensure the hazard will not occur either on the ground and/or in flight. This information is best presented in table format.

Tool Requirements	A list of all of the tools the team will use on the ground and in-flight with the experiment must be provided. Although teams are expected to provide all of their own tools for construction, operation and data collection; the number of tools brought to Ellington Field must be kept to an absolute minimum. All tools must be accurately inventoried and accounted for at all times as lost or misplaced tools can severely damage the aircraft.
Ground Support Requirements	Limited Ground Support services are provided through the Reduced Gravity Office, including: ground power & hazardous material storage. Each team should provide a detailed list of services that the team will be requesting from RGO.
Hazardous Materials	**Use of hazardous materials is discouraged.** Provide a list of all materials proposed for ground or in-flight use that are toxic, corrosive, explosive and/or flammable. List the quantities of each hazardous material to be used and describe how each will be used, stored, and safely handled. If storage on site at Ellington Field is requested, then state so. Material Safety Data Sheets (MSDS) must be included for all fluids and gases. MSDS is not required for breathing air and water.
Procedures	Explain the team's proposed operation procedures during the following program phases at Ellington Field: •**Ground Operations:** Set-up and ground testing of the equipment. •**Pre-Flight:** Set-up on the aircraft just prior to flight. •**In-Flight:** Equipment operation during various g-phases of the parabola. •**Post-Flight:** Processing flight data and preparation for a second flight.