What
If
No
Gravity?

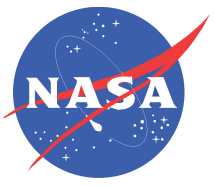
School year 2011/2012

Student teams in the fifty United States, the District of Columbia, Puerto Rico, American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands are eligible.

WING is for student teams in grades 5 - 8

Program Announcement

WING is a NASA educational program for teams of students to design and build an experiment to be tested in a NASA microgravity drop tower.



National Aeronautics and
Space Administration
Glenn Research Center

WHAT IS **WING?**

The What If No Gravity? (WING) is the middle school component of the NASA Dropping In a Microgravity Environment (DIME). Both WING and DIME are opportunities for students to experience the process of cooperative scientific investigation from start to finish. Student teams develop a hypothesis that can be tested through experimentation and then submit a research proposal. A panel of NASA scientists and engineers evaluate the proposals and select the best proposals.

WING is for teams with members in grades 5 through 8. Up to 30 proposals will be selected for full participation in WING. A WING microgravity experiment will be operated in the NASA 2.2 Second Drop Tower by NASA staff. Video data will be provided to the team after those operations and their experiment will be returned to the team.

DIME is for high school teams with team members in grades 9 through 12. A separate Program Announcement is available for DIME.

The annual WING and DIME competitions are open to teams of students located throughout the fifty United States, the District of Columbia, Puerto Rico, American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands.

Further information is available on the WWW at

`http://spaceflightsystems.grc.nasa.gov/DIME.html`

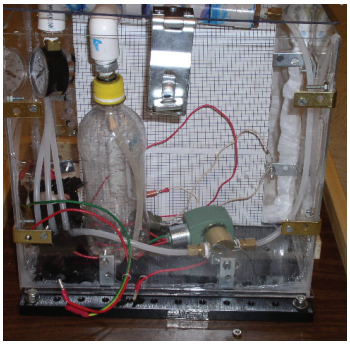
Questions and Comments

This brochure contains all necessary information for submitting entries to the WING competition. If you still have questions, please contact us at this address.

WING
NASA GRC, MS 77-7
21000 Brookpark Road
Cleveland, OH 44135

WING Key Dates (subject to change)

November 1, 2011	Postmark deadline for mailing proposal to NASA GRC
by December 1, 2011	Selected teams announced
by February 28, 2012	Delivery of experiment package to NASA
March 1 - 15, 2012	WING drop operations at NASA
April 30, 2012	Final report to NASA



Complex plumbing in a DIME 2003 experiment for water streams in microgravity

Learning Goals Aligned With National Education Standards

The WING program supports national standards in science and technology. Participation in WING will contribute to student mastery of these standards:

National Science Education

- Science as inquiry
  - + Understanding of scientific concepts
  - + Skills necessary to become independent inquirers about the natural world
- Science and technology
  - + Abilities of technological design

Science and Technology

- Design
  - + Students will develop an understanding of the attributes of design

Physical Science

- Forces and Motion
  - + An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.
  - + Unbalanced forces will cause changes in the speed or direction of an object's motion.

WING OVERVIEW

Microgravity is a condition in which the effects of gravity are greatly reduced compared to those experienced in normal conditions on Earth. The microgravity condition is easily created by a free fall within a gravitational field. Refer to the DIME Educators Resource Guide or the DIME web page for more information on microgravity.

Getting Started

This WING Announcement includes the core details needed to enter the WING competition. The web site contains additional information related to microgravity, the drop tower, and classroom activities.

The most important factor in developing a winning proposal is to select a topic that shows how the behavior of an object or experiment will change when in a microgravity condition. That behavior must also be observable and measurable in 2.2 seconds of microgravity which is the length of free-fall time in the NASA 2.2 Second Drop Tower. Information for guidance on selecting an experiment topic is contained in the *DIME Educators Resource Guide* which is available from the web site.

Requirements for the design of an experiment are contained in the *WING Experiment Design Requirements* section of this document.

WING Fundamentals

Developing a microgravity experiment need not be difficult. The following is a sequence of steps to develop a WING entry.

1. Develop a force & motion topic and select an experiment. Conduct a conceptual experiment in the classroom to investigate the topic. Test the effect of gravity on the experiment by dropping the experiment from a short height.
2. Develop a proposal and submit it as detailed on page 4 by the deadline shown on page 1.
3. Selection decisions will be annonced by NASA in early-December.
4. Upon selection by NASA, the team will build the proposed experiment in January and February. The experient design must follow the guidelines in the *WING Experiment Design Requirements* section of this document. The NASA staff can assist selected teams with guidance and support as the team continues through the process of building their experiment.
5. At the end of each month, the team will submit their preliminary design information to NASA for review. This will help to eliminate potential problems early.
6. If possible, the team should test the experiment in normal gravity (i.e. 1-g) for a baseline operation result. The microgravity test results can then be compared with the 1-g test results.
7. By the end of February, the team should submit their final design description to NASA and ship their experiment to NASA.
8. The NASA staff will drop the experiment in the drop tower and then forward the video data to the team. The experiment will also be returned to the team after its drop operations are finished.
9. The team should analyze the experiment results along with comments from the NASA staff to develop conclusions and observations about the experiment.
10. Finally, the team will prepare a final written report and submit it to NASA.

Evaluation

All entries will be evaluated by a team of scientists, engineers, and educators according to the selection criteria published in this announcement. Up to 30 WING proposals will be selected for development of the experiment by the team. Both selected and non-selected teams will be notified of the evaluation results.

Final Report

Following receipt of the team's experiment data from NASA, each team will prepare a final report and submit it to NASA.

WING EXPERIMENT DESIGN OVERVIEW

This section will assist a WING team with understanding the scope of their proposed experiment. This section contains a summary of the capabilities of the NASA drop tower and a summary of constraints on the team's experiment. The selected teams need to consult the WING Experiment Design Requirements section of this document for the applicable requirements prior to building their experiment.

In summary, a team's experiment will be placed in the NASA Education Rig for drop operations in the drop tower. The Education Rig provides a video camera and lights to support all experiments. On the other hand, the Education Rig also imposes some constraints on the WING team's experiment to ensure the experiment will fit and function properly.

The Education Rig provides the following equipment and capabilities.

1. A video camera (30 frames per second) with a zoom lens.
2. Lighting at the front or back of the experiment. The student team can chose front or back lighting or no lighting at all.
3. Electrical contacts are provided to indicate when the Education Rig and student experiment has been released into free fall. This may be used in the experiment design to initiate an action in the experiment.

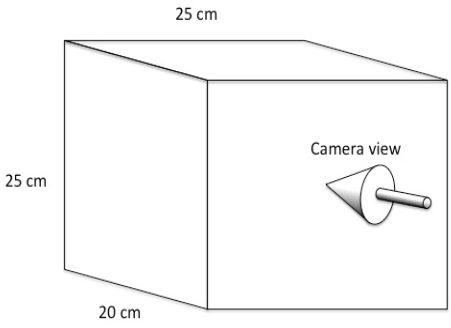


Figure 1: The student experiment must be sized within this rectangular solid in order to fit properly within the protective plastic box shown in Figure 2.

Remember that the selected teams must follow the requirements contained in the WING *Experiment Design Requirements* section of this document when designing and constructing their experiment.

Creating the experiment apparatus is a learning exercise in itself as students learn to design and build equipment to meet a specific need.

Parents, local high schools and colleges are additional sources that could be called upon to assist a team if these skills are not available in the school. Please remember, though, that the ideas, concepts, etc. for this work should be the product of the students, not the work of older students, parents, or professionals.

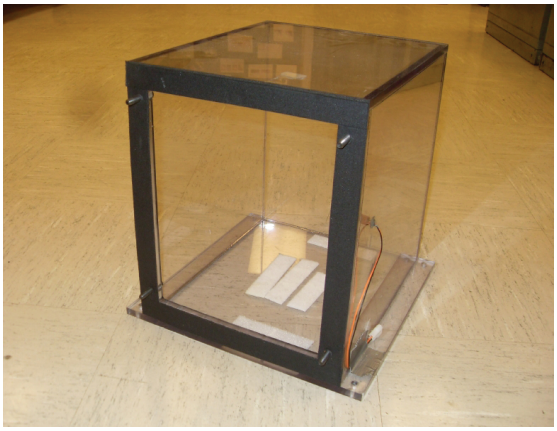


Figure 2: This protective plastic box is mounted in the Education Rig in the NASA Glenn 2.2 Second Drop Tower. The student experiments are mounted within the box for their operaiton.

WING EXPERIMENT DESIGN REQUIREMENTS

The WING team's experiment must abide by the following constraints.

Physical Constraints

1. The team's experiment must fit within the dimensions shown in figure 1.
2. The team's experiment will be mounted in a clear plastic box, figure 2, mounted inside the NASA Education Rig.
3. The NASA clear plastic box will have hook-type material on the floor to which loop-type material adhere. The NASA staff will attach loop-type material to the bottom of the team's experiment.
4. The team's experiment should weigh no more than 5 kg (11 lb).
5. The team's experiment will be mounted in the plastic box about 15 minutes before it is dropped. No access to the experiment is available after being mounted in the plastic box until the experiment is recovered following the drop. In other words, it will not be possible to manually push, turn over, or activate something within your experiment hardware just before the drop. See **Electrical Constraints** below. for electrical options.
6. If desired, the team's experiment may detect when microgravity occurs (in other words, when the experiment is released to fall) to activate the experiment. (See **Electrical Constraints** below.)

Electrical Constraints

1. The team's experiment may contain standard dry-cell batteries, such as AA, C, D, or 9-volt.
2. The maximum voltage allowed in an experiment is 28 volts.
3. A set of electrical contacts is available for the team to remotely activate the experiment, if desired. These contacts can be activated by a manual switch just before the experiment is released to fall. When the experiment is released to fall, the contacts change position to indicate the start of the free fall period. These contacts may be used, for example, to energize a solenoid, de-energize an electromagnet, or operate a motor.

Safety Constraints

1. Dangerous or hazardous chemicals or chemical reaction products shall not be used in the experiment.
2. Combustion experiments are not allowed for WING experiments. The following shall not be used in WING experiments: flammable gases, flammable liquids, explosives, fireworks, or model rocket engines.
3. Liquids and all other materials and components (with the exception of harmless gases), shall be contained within the team's experiment. The experiment apparatus shall not 'leak' if it is turned sideways or upside-down.
4. Biological samples, for the most part, shall not be used in the experiment, except for common household products (e.g. cotton, wood, etc.). Live animals, even insects, are not acceptable.
5. Experiment pressures shall not exceed 15 psig (pounds per square inch as measured on a gauge, relative to ambient pressure).
6. Lasers and radioactive materials shall not be used in an experiment.
7. The maximum voltage allowed in an experiment is 28 volts. Normal dry-cell batteries are allowed within a WING experment. The only electrical connection to the NASA Education Rig are the contacts mentioned in "Electrical Constraints," item 3.
8. A waiver, granting an exception to a safety rule above, may be requested by sending an e-mail with such a request to `dime@lists.nasa.gov` with an explanation of how any associated hazards will be controlled. Such waiver requests must be submitted no later than October 15. Note that waivers will not be granted for exceptions to the bans on lasers or radioactive materials.

Camera View Constraints

1. The team's experiment should be designed so the operation of the experiment can be seen by the NASA Education Rig camera. The camera view area at the front of the clear plastic box is a rectangle approximately. 10 cm wide by 7.5 cm high. The center of the rectangle is approximately 15 cm above the floor of the clear plastic box.

WING PROPOSAL PREPARATION

Proposal Components

In order to be selected to build and drop an experiment, teams must demonstrate that the student members of the team understand the forces and motion principles involved in their proposal. They need to be prepared to build their experimental apparatus to send it to NASA. The team will submit a proposal containing the five sections listed below. Sections I-III are limited to a total of 1000 words.

I. Forces & Motion Involved

A. Describe briefly and clearly the forces & motions involved in the experiment.

B. Describe what you expect to happen to your experiment in 2.2 seconds of microgravity. This is your hypothesis.

II. Technical Plan

A. Give a clear description of the experiment to be built. At least one figure or diagram of the experiment must be included in section IV of your proposal.

B. Describe what the camera will see before the experiment is dropped and when it is falling in microgravity for 2.2 seconds.

C. Describe testing the team will perform at your home location prior to sending the experiment to NASA.

D. Be sure the design meets the safety and design requirements as specified in the *Experiment Design Requirements* section of this document.

E. Describe how the results of your experiment will be used in the classroom to illustrate Forces & Motion.

III. Team Organization

Because experiment design, development, and operation is a team effort at NASA, this competition is designed to involve teamwork. In your proposal, include a description of the work necessary to carry out the proposed experiment, including the research to learn about your experiment. In particular, teams should include students able to perform the following kinds of tasks:

- Planning the work to be done
- Designing and building an experiment
- Conducting experiments
- Communicating the results of the project

IV. Figures

This section will contain from one to five single-sided pages of figures that illustrate the concept of the proposed experiment.

Evaluation Criteria

The proposal will be evaluated using a rubric (see page 8) with total points assigned as listed in that section.

WING Proposal Format

1. The proposal must be typed or computer-printed, double-spaced, using 12-point Times font, not bold or italic, and left justified. A 1-inch margin should be used for all sides of the pages. Portrait format shall be used for the pages.
2. Staple the proposal in the upper left corner.
3. Do not use a title page, folder or covers for the proposal.
4. The proposal title should be placed at the top of the first page.
5. Student names, advisor name(s), or any information that would identify the team, associated school or organization, or their location must not appear anywhere in the proposal. This will help ensure unbiased evaluation by the evaluators.
6. Team identification will be provided in the WING Entry Forms that accompany each proposal.

WING COMPETITION RULES

1. Teams located in the fifty United States, the District of Columbia, Puerto Rico, American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands are eligible to participate in DIME.
2. Team members must be students in grades 5 to 8.
3. Any school or organization may submit a maximum of four WING proposals in any one year. Adult advisors are encouraged to pre-select proposals for submission if more than four are prepared. In general, however, no more than one WING proposal each year will be selected from a single school or organization.
4. Each WING entry must be mailed in a single package. A WING entry comprises an Entry Form and three identical and complete copies of the proposal.
5. Late entries, entries sent by facsimile or electronic mail, and entries not complying with competition rules will be disqualified.
6. Entry materials will not be returned; please retain a copy for your records.
7. Proposals must follow preparation guidelines and format requirements as listed on page 5 of this announcement.
8. The WING entry must be postmarked by the date given on page 1 and addressed to:

   WING Proposal
   NASA GRC, MS 77-7
   21000 Brookpark Road
   Cleveland, OH 44135
9. Proposed experiments must conform to the requirements contained in the *WING Experiment Design Requirements* section of this document.
10. Safety rules for experiments are contained in the safety constraints section on page 4.
11. WING committee decisions are final.

WING Entry Form

Complete forms in blue or black ink. Please print clearly.

Proposal title

Grade Level(s) of team members (circle all that apply)

5 6 7 8

Proposal summary (maximum 100 words)

_____

_____

_____

_____

_____

_____

Adult Advisor Information

Lead advisor name: _____

Additional advisor name (optional): _____

Additional advisor name (optional): _____

Host organization: _____

Mailing address: _____

_____

_____

City: _____ State: _____ ZIP _____ - _____

Telephone number: _____ - _____ - _____ Fax number: _____ - _____ - _____

Lead advisor's e-mail address: _____

Host / organization WWW address: http:// _____

_____

We affirm that this team proposal for the WING program is original and has been conceived and developed by the team. We further affirm that we have read and understand the rules of the WING competition. We understand that entries are the property of NASA and may be used for publicity or outreach purposes. Copyrighted materials are properly identified and cited and permission has been obtained for their use.

Lead Advisor's signature: _____

Date: _____

WING Proposal Evaluation

Each entry package submitted for the WING competition will be evaluated by the process explained here.

The WING entries are received and cataloged by a WING administrator. Each entry package is first evaluated for adherence to the WING competition rules. Entry packages which do not conform to the rules are put aside and are not further evaluated.

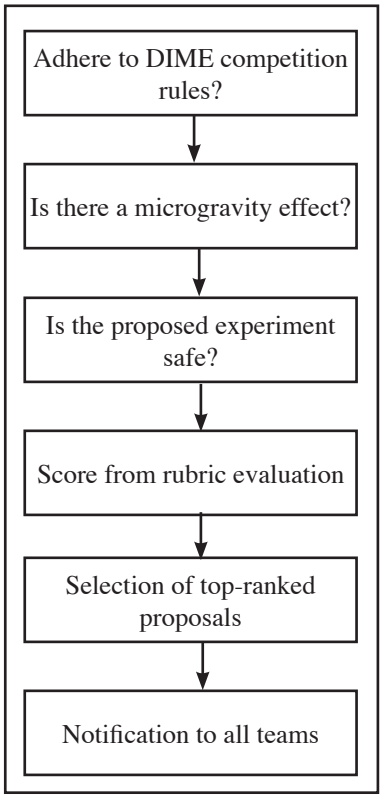
Please note that the WING rules state that proposals must be prepared in a manner which does not include team identification. This facilitates an evaluation by a panel of NASA scientists and engineers without bias to factors such as a team's location.

The WING program is intended for microgravity experiments where gravity has a significant effect. Therefore, all proposal research topics will be pre-screened for microgravity effects by the NASA panel.

Safety is a critical issue in test facilities. The proposals will also be pre-screened for issues which could jeopardize the safety of personnel and/or equipment. Early in a team's proposal preparation stage, a team may wish to contact the WING NASA committee to discuss the safety aspects of a proposed experiment concept.

The rubric in Tables I to IV is that which will be used by the NASA team to evaluate and score the WING proposals. A team should familiarize themselves with this scoring rubric when preparing a proposal. The rubric sections and the possible points by section are summarized in the table below.

If proposal scores are statistically close, selection preference will be given to proposing organizations who have not been selected in previous WING or DIME years and/or who are in geographical areas not represented in previous WING or DIME years.



WING Proposal Evaluation Flow

WING Proposal Possible Scores by Section

I. FORCES & MOTIONS INVOLVED	17
II. TECHNICAL PLAN	18
III. TEAM ORGANIZATION	5
IV. CREATIVITY	5
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Total	45

Table I. FORCES & MOTIONS INVOLVED

	A. RESEARCH QUESTION / HYPOTHESIS		
POINTS	1. Does the proposal have a clear use of forces & motion?	2. Is microgravity a major factor in this proposed experiment?	3. Will the experiment work in 2.2 seconds?
1	No mention of Forces & Motion in the proposal.	No clear connection to microgravity is explained.	Unable to detect factors in experiment to determine response time.
2	Forces & Motion is mentioned but its use is unclear.	The need for microgravity effect is unclear or was not explained clearly.	The information is unclear or not stated; the experiment samples may need to be modified.
3	A research question and hypothesis are present but both are poorly stated, or may contain inaccuracies.	A microgravity effect is clear and somewhat utilized in the experiment.	Response time short enough for reaction to be complete within 2.2 seconds.
4	A clear research question and hypothesis are present and variables are identified.	The microgravity effect is clearly stated and is utilized in the experiment.	N/A

	B. POTENTIAL BENEFITS	
POINTS	1. Potential results to illustrate Forces & Motion in classroom	2. Classroom discussion of the actions within experiment
1	No benefits cited in proposal or benefits are questionable.	No practical applications to classroom learning cited in proposal.
2	Benefits are cited.	Practical applications are cited.
3	Benefit cited as a reason for considering the experiment topic.	Practical applications cited as a reason for considering the experiment topic.

Table II. TECHNICAL PLAN

	A. DESIGN PLAN		
POINTS	1. Is there a clear and detailed description of the experimental apparatus?	2. Are legible drawing(s) included?	3. Will the design allow video and other data to be collected that documents the operation?
1	No technical description is presented.	No drawings are included.	Plan mentions data or data analysis, but provides no specifics.
2	A good start, but many key questions are not addressed. Plan is not clearly described; there appear to be serious technical problems.	Good drawings, but not enough detail.	Plan will likely yield relevant data, provides plans for appropriate analysis, but has some issues.
3	Reasonably clear, but some key questions are not addressed. The experiment seems practical.	Good drawings, but some key details are not addressed.	Plan will likely yield relevant data, plans for appropriate analysis are practicable, and requires little, if any, modification.
4	Clear and thorough, most key questions are addressed. The technical description is clear and complete or requires only small changes to adapt the experiment to the drop tower.	Clear and thorough drawings with key questions addressed.	N/A

	B. DESIGN SAFETY	TESTING AT HOME LOCATION
POINTS	Does the design meet the safety and interface requirements?	Does the team describe the testing they will do in their home location before shipping experiment to NASA.
1	Information presented is vague or confusing.	No discussion about testing is mentioned.
2	A good start, but many key questions are not addressed. Information is not clearly described; there appear to be serious problems.	Testing was mentioned but detail on the testing is not discussed.
3	Information is reasonably clear, but some key areas are not addressed.	Both discussion of the testing to be done in the classroom is mentioned and details on how it is done is given.
4	Clear and thorough, most key areas are addressed. The information is clear and complete or requires only minor changes to meet requirements.	N/A

Table III. TEAM ORGANIZATION

	A. Evidence of relevant skills and experiences	B. Team Support
POINTS	The proposal states clearly the contributions and skills for each team member and how all the members of the team will share an appropriate distribution of workload and responsibilities.	Has the team effectively enlisted the support and cooperation of the school and community?
1	No information is provided.	No information is provided.
2	Description of division of labor is provided.	The team presents a plan to enlist the support they require.
3	N/A	Qualified individuals are listed along with their skills.

Table IV. CREATIVITY, ORIGINALITY, ATTENTION TO DETAIL

POINTS	1. The proposal shows a creative way to study an idea.	2. The proposal shows attention to detail through correct spelling/ grammar/ format.
1	No creativity applied. Simple use of standard lab experiment.	Spelling errors, grammatical errors, and/or format problems are very evident.
2	Creative experiment idea for microgravity investigation.	Some such errors exist, but are not prevalent.
3	N/A	No problems in this area.

Acknowledgements

The ***What If No Gravity?*** and ***Dropping In a Microgravity Environment*** programs are a cooperative effort of many organizations.

- Teaching From Space Program, NASA Johnson Space Center, Houston, Texas
- Educational Programs Office, NASA Glenn Research Center, Cleveland, Ohio
- ISS and Human Research Project Office, NASA Glenn Research Center, Cleveland, Ohio
- Space Processes and Experiments Division, NASA Glenn Research Center, Cleveland, Ohio
- National Center for Space Exploration Research, NASA Glenn Research Center, Cleveland, Ohio
- Office of Education, NASA Headquarters, Washington DC

Critical support comes from the staff of the NASA Glenn 2.2 Second Drop Tower and other NASA Glenn Research Center organizations.

Documents and other information related to the WING and DIME programs may be accessed at the following World Wide Web address:

`http://spaceflightsystems.grc.nasa.gov/DIME.html`

NOTE:

Use of commercial names and products does not imply an endorsement by NASA.