WING 2012

NASA'S MICROGRAVITY EDUCATIONAL PROGRAMS

There are several major educational programs within NASA that allow students and educators to experience the thrill of designing, building, and operating experiments in a microgravity or weightless environment. While some of these programs utilize the International Space Station in orbit around the Earth, other programs utilize ground-based facilities such as sounding rockets, aircraft and drop towers.

The **Dropping In a Microgravity Environment** (DIME) and **What If No Gravity?** (WING) competitions provide such an opportunity for high school-aged student teams and middle school-aged teams, respectively. DIME and WING experiments, designed and built by students, are operated in the 2.2 Second Drop Tower at the NASA Glenn Research Center in Cleveland, Ohio. The WING competition is described here.

WING PROCESS

Student participating in WING will experience an end-to-end science or engineering process similar to that encountered by scientists and engineers. Students will define the experiment, build the experiment apparatus, provide instructions for NASA staff to operate the experiment in a drop tower, analyze the test results, and write a final report to summarize the experiment.

A student team should learn about microgravity. The team members should also become familiar with the WING rules (see Appendix 1). The team develops an idea for a test or experiment involving microgravity for a short period of time.

The team needs to develop a proposal in accordance with the WING rules and submit the proposal to NASA before the deadline. The NASA staff evaluates all the submitted WING proposals according to the rubric in Appendix 2. NASA selects up to 30 teams to continue the WING program. If a team's proposal is selected by NASA, the team develops their experiment according to guidelines for safe and proper operation in the drop tower. The team builds and tests their experiment at their home location. When the experiment is complete, the team packages it and ships it to NASA. The NASA staff operates the experiment in the drop tower and supplies the team with video results for the experiment. At that time, the team analyzes the data and writes a final report of their experiment.

MICROGRAVITY EXPERIMENT

During the 2.2 seconds of free-fall time in the drop tower, the team's experiment will experience microgravity or "weightlessness" in which the experiment will feel like gravity has gone away.

The team's experiment should have some effect by gravity that will be different when the experiment is dropped and it "feels" like there is no gravity. An experiment ought to have an internal force that is influenced by gravity. Such internal forces are typically from magnets, springs, rubber bands, capillary fluids, fluid surface tension, and density differences. Additional information to assist with understanding microgravity and the DIME program is available from the sources in Appendix 3.

For example, placing a stone in the clear plastic box as an experiment would not result in any significant change when the experiment was dropped. If the stone were placed on a spring, though, gravity would pull the stone downward and compress the spring. During

the drop, then, the experiment would 'feel' like as if there is no gravity and the spring would stretch out to its original length, and throw the stone upward.

EXPERIMENT OPERATIONS

The team's experiment is placed in a plastic box that is mounted in a larger carrier for operation in the NASA Glenn 2.2 Second Drop Tower. This carrier, called an Education Rig, includes a camera and lens, and provides electrical control contacts (if needed) to the team's experiment.

SIZE

The WING team's experiment must be no larger than the dimensions shown in Figure 1. Those dimensions are 26 cm wide, 23 cm tall and 19 cm long. The size relative to the camera is also important for the camera to view the experiment properly.

The experiment is placed on the floor of the plastic box and is held in place by hook-and-loop fastener material (supplied by NASA).

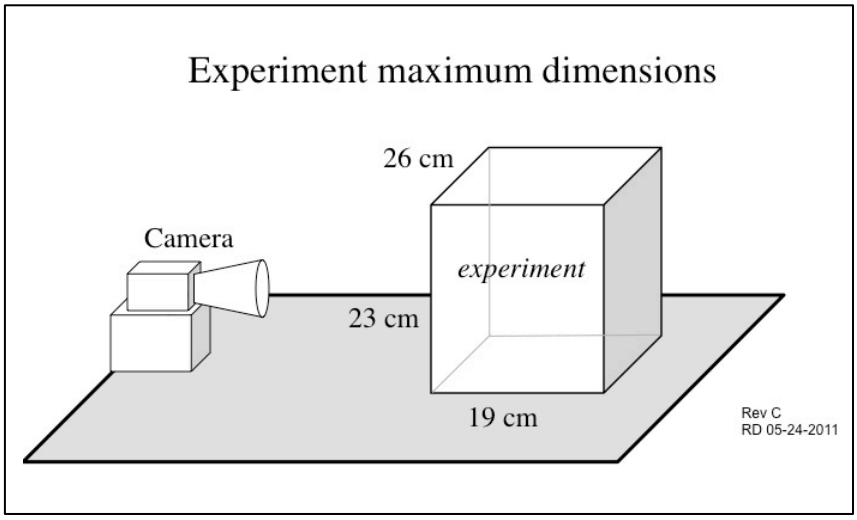

Figure 1: The student team's experiment must be sized no larger than that shown in this figure.

CAMERA VIEW

The camera may be moved up and down a few inches. The camera sees the lower-middle of the experiment volume shown in the figure.

ELECTRICAL

The Education Rig provides relay contacts (i.e. switches) that can control parts of a team's experiment before the microgravity period, at the beginning of the microgravity period, and at a preset time during the microgravity period. The electrical connections to the relay contacts are accomplished with simple, inexpensive 'banana' connectors.

During the experiment design phase of selected experiments, assistance will be offered by the NASA staff for teams that need such connections.

For example, a team may want to electrically activate a battery-powered electromagnet when the microgravity period starts.

PROPOSAL

A team needs to describe their experiment in a proposal that is sent to NASA. The NASA staff evaluates all valid proposals submitted by teams and will select up to 30 proposals each year.

Upon selection, the NASA staff will offer suggestions to help the team make the experiment successful and will help each team during the experiment development time.

A valid WING proposal needs to contain the following information.

I. Experiment Title
   Create a short but descriptive title.

II. Hypothesis
   Explain your hypothesis that involves a gravity or microgravity effect.

III. Experiment Summary
   Write a short description of your experiment. Explain what you think will happen in terms of forces and motion during the drop tower free fall time. Explain what force opposes gravity when the experiment is not falling. Explain what happens due to that force during the free fall time. Explain what has to start your experiment. It can be the sudden feeling of 'no gravity' or something else.

IV. Safety
   Explain why your experiment is safe and will not hurt any equipment or people. For example, fire, hazardous chemicals, and animals (even bugs) are not allowed as part of an experiment.

V. Figures
   Include drawings that describe what your experiment apparatus will look like and how it will work. These drawings should relate to your descriptions in the experiment summary. Be sure to label the parts of the experiment. The approximate size of major parts and the overall size should be included.

CONTACT NASA STAFF FOR QUESTIONS OR COMMENTS

If you have questions about any aspects of the WING program, please do not hesitate to contact the NASA staff. For telephone inquiries, call Nancy R. Hall at 216-433-5643. For e-mail inquiries, send your comments or questions to: `dime@lists.nasa.gov`

APPENDIX 1: WING RULES

1. Teams located in the fifty United States, the District of Columbia, Puerto Rico, American Samoa, Guam, Commonwealth of the Northern Mariana Islands, and the U. S. Virgin Islands are eligible to participate in WING.
2. Team members must be students in grades 6 to 8.
3. Any school or organization may submit a maximum of four proposals in any one year. Adult advisors are encouraged to pre-select proposals for submission if more than four are prepared.
4. Each proposal must NOT contain identifying information about the team, the team's school or organization, city, or state. A WING Entry Form (see next page) must accompany each proposal.
5. Each WING entry, consisting of a valid proposal and a WING Entry Form, must be mailed in a single package.
6. Entry materials will not be returned so please retain a copy for your records.
7. The WING entry must be postmarked by November 1 and addressed to:
   WING Proposal
   NASA GRC, MS 77-7
   21000 Brookpark Road
   Cleveland, OH 44135
8. Safety rules for experiments:
   a. Hazardous chemicals or chemical reaction products must NOT be used in the experiment.
   b. 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.
   c. Liquids and all other materials and components (with the exception of harmless gases), shall be contained within the team's experiment. The experiment apparatus should not 'leak' if it is turned sideways or upside-down.
   d. Biological samples, for the most part, may not be used in the experiment, except for common household products (e.g. cotton, wood, etc.). Live animals, even insects, are not acceptable.
   e. Experiment pressures may not exceed 15 psig (pounds per square inch as measured on a gauge, relative to ambient pressure).
   f. Lasers and radioactive materials shall not be used in an experiment.
   g. The maximum voltage allowed in an experiment is 28 volts. Normal dry-cell batteries (e.g. AA, C, 9-volt) are allowed within a WING experiment.

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)

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: _____

APPENDIX 2: WING PROPOSAL EVALUATION RUBRIC

This rubric will be used by the NASA to evaluate the proposals received in this competition.

5/25/11				
	3	**2**	**1**	**0**
Gravity effect included	Expected change from 1-g to microgravity clearly explained. Element will be obvious in camera view.	Some definition of what change the team expects from 1-g to microgravity.	Something will happen to experiment in 1-g to microgravity change, but proposal does not recognize it or explains incorrectly.	No microgravity effect included in proposed experiment.
Demonstration of Forces & Motions	Proposal shows understanding of forces involved in proposed experiment.	Some mention of forces and expected motions are included in proposal.	Expected motion is mentioned in proposal.	The proposal does not exhibit an understanding of forces or motions involved.
Size	Proposed experiment will fit in Education Rig clear plastic box with no issues. Drawing in proposal indicates sizes of components.	Dimensions shown in drawing are unclear. Size is probably adequate.	No dimensions given in proposal drawing, but size seems possibly adequate.	No dimensions given in proposal drawing. Size of experiment is questionable for proper fit in box.
Scientific Method	Experiment concept will produce to data to assess hypothesis.	Experiment concept will produce some data related to hypothesis.	Experiment concept will produce data.	Experiment data does not relate to hypothesis.
Safety	Demonstration of Safety included. Safety plan and considerations included.	Demonsration of safety in most of experiment Safety plan and considerations included.	Demonstration of safety in parts of the experiment. Few safety considerations included.	No safety considerations. Potential for danger and/ or accidents when experment is built or tested.

APPENDIX 3: REFERENCES AND RESOURCES

These items contain useful information about DIME and microgravity.

1. WING website
   http://spaceflightsystems.grc.nasa.gov/WING.html
2. 2.2 Second Drop Tower website
   http://facilities.grc.nasa.gov/drop/
   Additional information about the 2.2 Second Drop Tower at the NASA Glenn Research Center is available. A description of the drop tower in text and pictures is available there.
3. DIME and WING YouTube channel
   http://youtube.com/user/dime10nasa
   A YouTube channel has been established for DIME and WING. That channel contains more videos that illustrate the drop tower and a few of the previous experiments constructed by DIME teams.
4. DIME and WING have a FaceBook presence.
   http://www.facebook.com/#!/pages/NASA-DIME/188345970210