AC 2008-1575: “MICROGRAVITY RESEARCH TEAM” (MRT) PROJECT COURSE

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“Microgravity Research Team” (MRT) Project Course

Abstract

Over the past eight years at West Virginia University a “hands-on” aerospace engineering experimental Microgravity Research Team (MRT) two-semester project course sequence has been developed and offered. During the first semester, the team of four to eight undergraduate students develops an experimental concept and hypothesis to be studied under microgravity conditions, and then submits a detailed technical proposal for their experiment for review by the NASA Reduced Gravity Student Flight Opportunities Program (RGSFOP). Six successful experiments have been selected and flown on microgravity research aircraft in the past eight years, with a seventh team selected to fly their experiment during the summer of 2008. The student teams also perform outreach to local area school children, develop an accurate project budget, and engage in fund raising activities. During the second semester the team conducts the actual detailed design, constructs and tests their experimental apparatus, and submits the required engineering design and safety analysis document, the “Test Equipment Data Package,” to NASA. This report is analyzed by NASA engineers, and any concerns they raise are addressed by the team to ensure that their experiment will be accepted for the actual reduced gravity flights. Either during this semester, or during the following summer, the team travels to NASA Johnson Space Center to conduct their research aboard the NASA microgravity research aircraft. Afterwards, the experimental results are reduced and analyzed, and a final technical report containing their analysis is submitted to the NASA RGSFOP. Outreach continues through this second semester; these outreach activities are also documented in the final report. As part of the outreach activities, a website is maintained to document and publicize the projects. The main course goal is to provide students with a hardware-oriented, hands-on, open-ended research project experience. This course can fulfill a technical elective requirement in either the Aerospace Engineering or Mechanical Engineering curriculum.

The six experiments that have been conducted by the West Virginia University MRTs over the past eight years are, in chronological order:

1. Control of a surface tension-driven corner flow in microgravity,
2. Control of liquid sloshing in microgravity via the magnetic Kelvin force,
3. Control of air bubble behavior in microgravity via the magnetic Kelvin force,
4. Circular hydraulic jump behavior in microgravity I: low flow rate,
5. Control of boiling in microgravity via the magnetic Kelvin force,
6. Circular hydraulic jump behavior in microgravity II: high flow rate, and
7. Viscous and capillary fingering in a Hele-Shaw cell in microgravity (to be flown in summer 2008).

Overviews of the experiments that have been conducted and course procedures are given. Examples of the many positive personal and professional outcomes experienced by student participants are also recounted. Lessons learned by the faculty advisors and suggestions for other schools planning to participate in this program are summarized.
Introduction

Over the past eight years, a hands-on Microgravity Research Team (MRT) two-semester project course sequence has been developed and offered at West Virginia University (WVU). This course can fulfill a technical elective requirement in either the Aerospace Engineering or Mechanical Engineering curriculum. The primary course goal is to provide students with a hardware-oriented, open-ended, hands-on research project experience. Each fall, the student team develops an experiment concept, and proposes their unique experiment to the NASA Reduced Gravity Student Flight Opportunities Program (RGSFOP) at the NASA Johnson Space Center. If selected by NASA for flight, the team then completes the design, construction, and testing of their experiment during the spring semester, and then flies their experiment aboard the NASA research aircraft either during the spring semester or during the following summer. The RGSFOP program was established by NASA to provide students with a high-quality experience in the development and conduct of a research mission in microgravity (more accurately, “reduced gravity”) conditions.

The 2007 annual report of the RGSFOP\(^1\) gives an overview of the development of this program; two initial reduced-gravity programs were run in 1995 and 1996, consisting of flights for student teams from four Texas universities; this initial program was called “SURF”, for “Students Understanding Reduced Gravity Flight.” The program was patterned after the successful European Space Agency student parabolic flight campaign, and was formed after NASA participation in this program. The program was re-named RGSFOP, for “Reduced Gravity Student Flight Opportunities Program”, in fall 1996, and opened to 23 student teams from across the United States in 1997. The program was expanded to include 47 teams in 1998, with 44 teams selected in 1999, and 48 teams in both 2000 and 2001. Further expansion led to 72 and 69 teams being selected for flight in 2003 and 2004. The ageing KC-135 aircraft was replaced with the current C-9 in 2005; however, due to maintenance and modification problems, only 10 teams flew in 2005. A total of 65 teams were selected to fly in 2006; but, due to program funding cuts, only 34 teams were selected to fly in 2007; and 40 teams have been selected in 2008. A RGSFOP program web site gives details of program deadlines and procedures\(^2\).

RGSFOP Participation at West Virginia University

West Virginia University participation in the NASA RGSFOP began in 2001, with an initial student team (MRT1, for “Microgravity Research Team 1”) consisting of four members, who developed an experiment to study the effects of the magnetic Kelvin force on a surface tension-driven flow in a wedge under conditions of microgravity; see Figure 1. This experimental concept was suggested to the project advisors by Dr. Ewan Alexander of the then National Center for Microgravity Research (NCMR) during a visit to NASA Glenn Research Center. Our initial involvement in RGSFOP was stimulated on two fronts: first, the first author heard two papers\(^3,4\) about the RGSFOP while attending the AIAA 39\(^{th}\) Aerospace Sciences Meeting in January 2001 to present a research paper on Doppler velocimetry\(^5\). Both of these papers made it clear that the RGSFOP was an exceptional educational experience. There were several unsolicited testimonials from young aerospace engineers in the audience as to this fact. Second, the first author was approached by Matthew Lechliter, a WVU undergraduate majoring in Aerospace Engineering who was searching for project advisor(s) to form a team to participate during that spring semester. Apparently, a junior faculty
colleague had agreed to serve as project advisor, but then decided to leave WVU at mid-year to be closer to his family. These nearly simultaneous, serendipitous events have led to the development of the present MRT project course at WVU, an activity that has been beneficial and enjoyable to both the students and faculty advisors.

The experiment was flown in August 2001, and documented the ability of the magnetic Kelvin force to reduce or overcome the effects of surface tension in a reduced gravity environment; see Figure 1B.). The liquid interface on the right side of the photo is prevented from rising up vertically in the wedge-shaped corner by the strong permanent magnet at the bottom of the wedge region. MRT1 received significant guidance from Dr. Steven H. Collicott of Purdue University in the development of their TEDP (“Test Equipment Data Package”). Largely due to his participation in the WVU MRT1 corner flow experiment, Lechliter was selected as a 2000-01 Goldwater Scholarship recipient.

MRT2 also studied effects of the magnetic Kelvin body force, this time on reduction of paramagnetic liquid sloshing in partially filled tanks in microgravity; this experiment was conceived by the student team and was inspired by the problem of controlling the distribution of liquid oxygen (a paramagnetic liquid) in a propellant tank for engine restart after a period of microgravity. As shown in Figure 2, MRT2 was expanded to eight members, with four new members serving as “ground crew”. The addition of ground crew was envisioned as a means of reaching twice as many students per flight campaign, while also improving “corporate memory” of the team and hopefully motivating the new team members. Again, successful results were obtained, in that the magnetic Kelvin force helped to keep the paramagnetic liquid solution confined at the bottom of the tank in microgravity after an impulse load, as seen on the left hand side of Figure 2B.).

A third Kelvin body force experiment was flown by MRT3 in July 2003; see Figure 3. This team studied the behavior of air bubbles injected at the bottom of a tank of paramagnetic liquid in microgravity. The Kelvin force caused bubbles to pinch off and to be driven away from the bottom of the tank, much as in normal Earth gravity, as seen in the tank on the left hand side in Figure 3B.). In the control tank without the Kelvin force, very large bubbles remained near the gas injection port during microgravity.
After these three successful proposals, two teams submitted unsuccessful RGSFOP proposals in 2004 and 2005. These proposals aimed to apply the magnetic Kelvin force to control actual pool boiling under microgravity conditions, but the RGSFOP reviewers felt that this experiment was too similar in concept to the initial three experiments. Both teams then revised their proposals and submitted them to the Zero-G Corporation to fly on their B-727 microgravity aircraft. In both years, this possibility fell through, either due to delays in receiving FAA certification by Zero-G or cancellation of the research flight. The fourth successful WVU project, by team MRT4, studied the behavior of the circular hydraulic jump (CHJ) in microgravity; see Figure 4. This experiment was flown in July 2006, and yielded some useful data, where the diameter of the CHJ was observed to increase in microgravity relative to its diameter in hypergravity. However, the pump capacity was inadequate to fully wet the circular impingement plate; see Figure 4B.). This indicated the need for an improved experimental apparatus. MRT4 member Kerri Phillips was selected as a 2005-06 Goldwater Scholarship recipient.

Also during the summer of 2006 MRT5 finally flew the pool boiling experiment aboard the Zero-G Corporation B-727 microgravity aircraft; see Figure 5. This experiment documented a (limited) ability of the magnetic Kelvin body force to influence vapor bubble behavior during pool boiling in microgravity; see Figure 5B.). At the same heat flux, bubbles
were smaller under the influence of the Kelvin force. However, the vigorous rolling boil was unanticipated, and was an extremely strong test of the experimental hypothesis. MRT5 team member Thilanka Munasinghe became the first citizen of Sri Lanka to fly a microgravity flight. Munasinghe’s experiences were featured on Sri Lankan national television during his visit to his home in the summer of 2007 and resulted in a personal interview with famed science writer and Sri Lanka resident Arthur C. Clark.

A.) MRT4 and C-9, 7/06

Figure 4. WVU Microgravity Research Team 4 (MRT4): circular hydraulic jump in microgravity.

B.) Sample results

A.) MRT5 and Zero-G B-727, 8/06

Figure 5. WVU Microgravity Research Team 5 (MRT5): boiling in microgravity.

B.) Sample results

The most recent WVU microgravity project was flown by MRT6 during March 2007. This experiment was a significant upgrade of the CHJ flown by MRT4 in 2006; see Figure 6. Very successful results were obtained; these results were presented by MRT6 team members Mehran Mohebbi and Jonathan Painter at the national CANCAM conference in Toronto in June 2007.

During the current, eighth year of WVU’s participation in the RGSFOP, MRT7 has had their proposal to study viscous and capillary fingering in a Hele-Shaw cell in microgravity accepted for a June 2008 flight week.

Over the past eight years, these experiments have shown a steady increase in complexity, from the quite simple corner flow experiment of MRT1 in 2001 with basically no operator input, no electric power, and no data other than video and photography, to the experiments of MRT6 and MRT7 that required a significant amount of operator input to
obtain useful data, and digital data acquisition of accelerometer and flow rate data, along with the video and photographic data. Summaries of the WVU MRT projects are shown on the project web page\(^7\). Several WVU team members have given technical presentations or posters about their experiments\(^8-16\), as well as making presentations at college and departmental recruiting sessions and local secondary schools, as part of their outreach activities. The WVU public relations office has prepared videos featuring the MRTs in television and internet spots and for presentation at graduation ceremonies.

![Image of WVU Microgravity Research Team 6 (MRT6): circular hydraulic jump in microgravity.](image)

A.) MRT6 in C-9, 3/07  
B.) Sample results

Figure 6. WVU Microgravity Research Team 6 (MRT6): circular hydraulic jump in microgravity.

**Description of West Virginia University Microgravity Research Course**

The Microgravity Research Team project course at West Virginia University has evolved over the past eight years into a two semester sequence of three credit 400-level courses that may be taken by senior, junior, and sophomore students. Three course credit hours may be utilized by Mechanical Engineering or Aerospace Engineering majors to fulfill one of their professional technical elective degree requirements. Students who are pursuing the WVU dual BSME/BSAE degree program may use both courses to fulfill technical elective requirements in both their ME and AE curricula.

The student team is determined early in the fall semester. Posters are hung throughout the engineering buildings to publicize an information session to describe the course to anyone who might be interested in participating. Students who are interested in participating submit resumes and are interviewed by the course instructors during the first week of the fall semester. In the future, we are considering moving this selection process to late in the prior academic year. This would increase the time available to the team for proposal writing. The enrollment is generally held quite low, between 4 and 12 total students. This is due to the high cost for a student team to participate in the RGSFOP, and because of the time required of the advisors. Ideally, all four of the ground crew from the prior year will return to become the flight crew of the current flight campaign, and four new team members are recruited to serve as the new ground crew. In these circumstances, priority would be given to the best qualified underclassmen. If there are fewer than four returning team members, then a greater number of new team members are selected, and some of these new team members will serve as flyers during their first year of participation. The only prerequisite for this course sequence is sophomore standing; the course instructors attempt to attract students from all engineering
majors, although to date only one student has not been a Mechanical Engineering or Aerospace Engineering major.

Once the team has been selected, during the fall course they are guided in the process of conceiving, proposing to the NASA RGSFOP, developing, and testing a new experiment to be conducted aboard the NASA microgravity research aircraft. If accepted, these experiments are then constructed, optimized, and tested by the MRT in the second course, taught in the spring semester. Also during the second semester course, the required engineering and safety document, the TEDP (“Test Equipment Data Package”) is submitted to NASA RGSFOP, and any concerns or problems that are identified by the NASA reviewers are addressed. If the proposal is rejected by NASA, the MRT may either disband or continue working with the intention of seeking an alternative flight opportunity such as with the Zero-G Corporation.

The team uses a combined classroom/laboratory space to which they have keys, in order to enable access whenever necessary. Unfortunately, this space is shared with the students who are participating in the WVU “Balloon Satellites” project course that is taught during each spring semester. This generally causes some conflicts (primarily, for work space) towards the end of that semester, when the Balloon Satellites students are completing their electronics payloads prior to their balloon launch. Access to the departmental machine shop and machinist time are provided to assist in the completion of the necessary experimental hardware.

Student teams work with the course instructors/advisors to develop an accurate budget during the fall semester. Students generate estimates of the anticipated travel costs and the costs to construct their experimental apparatus. This budget amount must then be agreed upon each year by the parties who provide the funding. Currently, funding for the projects is provided primarily by the West Virginia NASA Space Grant Consortium and the WVU Mechanical and Aerospace Engineering Department, with some travel funds also coming from the WVU College of Engineering and Mineral Resources. During the first couple of years, the College provided a greater level of financial support (as much as 40% of the total funding). The student team also solicits donations from local area aerospace engineering businesses; this effort has not been very successful to date, but has been helpful in convincing our existing sponsors from within WVU to continue their levels of support. The approximate cost of the program each year has been between $20K to $16K, covering the travel costs (rental vehicles and gas, hotel rooms, and airfare) for the 8 to 10 participants (MRT students and/or faculty) to travel to NASA JSC to participate in the 10 day flight campaign, plus the cost of the experimental hardware. Team members are expected to cover their own meal and entertainment costs on the trip to Ellington Field. Program costs have trended downwards slightly over time, as we have found ways to reduce travel costs (drive the experiment to Houston if it is too large to ship via UPS; have the advisors stay home), and as we have been able to reuse some experimental hardware (experiment frames, accelerometers, laptop, cameras, etc.). The MRT5 flight aboard the Zero-G Corporation B-727 aircraft was somewhat more expensive, due to the $15.5K cost of the flight itself. However, this was partially offset by a reduction in travel costs, since that program only lasts a couple of days, and the entire team was able to drive to NASA Kennedy Space Center for the flights.
To date, these courses have all been taught under the MAE 493 Special Topics, MAE 495 Independent Study, and/or MAE 496 Senior Thesis course numbers. This has made it quite difficult to schedule course meeting times; especially in years when the team composition has been more diverse (members from more different majors; or in more different years in school). Generally, only a couple of hour-long full team meetings have been scheduled each week, with smaller subgroups meeting as needed outside of normal course hours. Often, these meetings have been at the end of the work day. In some years, this has placed limits on team cohesiveness and productivity.

As a result of these problems or limitations, over the past year we have recently gotten the courses formalized as permanent technical elective courses: MAE 430 Microgravity Research I and MAE 431 Microgravity Research II. These courses will be taught for the first time during the 2008-09 academic year. It is planned that six hours of regular class time will be scheduled; this is expected to improve team productivity, as well as ease the administrative burden on the course instructors. The planned course schedules are outlined below, where the spring semester schedule has been prepared assuming that the team is selected to fly during their spring break. Course schedule would adjust as necessary if a different flight week is assigned to the team.

**Fall Semester:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Intro: NASA RGSFOP, MAE Ground Rules, Team Formation</td>
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<tr>
<td>Week 2</td>
<td>Initial Expt'l. Research; Experiment Brainstorming</td>
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<tr>
<td>Weeks 3-8</td>
<td>Proposal Development/Writing/Editing/Budget Development</td>
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<tr>
<td>Week 8</td>
<td>Submit Proposal to NASA RGSFOP</td>
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<tr>
<td>Weeks 9-15</td>
<td>Initial Experiment Design; Place Orders for Long Lead-Time Parts</td>
</tr>
<tr>
<td>Week 14</td>
<td>Notification of Proposal Acceptance/Rejection</td>
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<tr>
<td>Continuous</td>
<td>Fund Raising Activities and Outreach Activities</td>
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**Spring Semester***:

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<tr>
<th>Time</th>
<th>Description</th>
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<tr>
<td>Week 1</td>
<td>Review Preliminary Design from Fall Semester</td>
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<tr>
<td>Weeks 2-10</td>
<td>Finalize Experiment Design; Experiment Construction</td>
</tr>
<tr>
<td>Week 5</td>
<td>Submit TEDP to NASA RGSFOP</td>
</tr>
<tr>
<td>Weeks 9-10</td>
<td>Testing/Modification of Completed Experiment</td>
</tr>
<tr>
<td>Weeks 10-11</td>
<td>Travel to NASA JSC; Fly Experiment</td>
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<tr>
<td>Weeks 12-15</td>
<td>Analyze Data from Experiment</td>
</tr>
<tr>
<td>Weeks 15-16</td>
<td>Submit Final Report to NASA RGSFOP</td>
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<tr>
<td>Continuous</td>
<td>Outreach Activities and Budget Monitoring</td>
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*Note: Actual class schedule varies from year-to-year, based upon changes to overall NASA RGSFOP schedule, and specific flight week assigned by NASA.

**Lessons Learned and Benefits to Project Participants**

The West Virginia University Microgravity Research Team (MRT) project course has been a very valuable experience for the participating student team members, as well as benefiting the course instructors. Over the past eight years, we have adapted the project to changes in the NASA RGSFOP program schedule and scope. However, while we are generally pleased with the current status of the project course sequence, we have some
observations and recommendations for those who might be considering creating a similar project course at their university.

First, while it seems undeniable that the value of the program to the participants is extremely high, it is also true that the cost of the program on a per student basis is high. Structuring a MRT program that would reduce these costs would make securing the program funds each year easier, as well as possibly enabling the project to reach a greater number of students for a given level of program resources. For example, the RGSFOP project course taught by Dr. Steven H. Collicott at Purdue University is offered as one section of the required senior year capstone design course in the Aerospace Engineering curriculum. That course is structured such that several local teams are formed, and at least two project proposals are formally submitted to the RGSFOP program, with the best from among the local project plans being selected for submission to RGSFOP. This obviously would be a better format, but is only feasible with a greater commitment of resources from the offering department (e.g., what appears to be secure funding for two or more teams per year, and full course load credit for the course instructor). However, at WVU the Aerospace Engineering senior capstone design course has always been, and appears likely to remain for the foreseeable future, a traditional aircraft conceptual design project, with no hardware, construction, or testing. This fixed curricular constraint forced us to initially offer the course as a special topics course, and also perhaps led to our not moving ahead to create a regular senior technical elective course as early in the program as we should have. The fact that for the first four to six years, neither of us received any formal teaching load credit for our participation as project mentors/course instructors may have also led to our inaction on this front. We strongly recommend that others more forcefully advocate for a full place in their Aerospace or Mechanical Engineering curricula for their MRT/RGSFOP courses. While it may be true that AEs may do less “hands on” work on the job than a typical ME, exposure to the open-ended design and research project environment sometime during the second half of the undergraduate experience is very often both a great motivator for students, as well as providing an environment for the student to mature professionally. Making the course a capstone course need not prevent participation by students from other majors, and would provide a more multidisciplinary experience, if the course instructors are flexible enough to allow enrollment on a “by consent” basis.

Second, clearly, the course and projects will be better if the faculty effort is fully recognized, and regular teaching load credit is assigned by the respective programs. The MRT experience has been extremely enjoyable and rewarding for us on a personal level, but doing it “out of your hide” eventually takes away from the experience.

Third, we have come to realize that our own professional backgrounds and interests have placed constraints on the types of projects that can be successfully proposed by the WVU MRTs. We are both primarily fluid mechanics/thermal sciences faculty, and have required all of the student teams to only consider and brainstorm projects in these technical fields. With the technical elective course that we are able to offer here, this is not a severe limitation, but for an AE capstone design project course, it would be much better to develop more flexible course instructor/project advisor staffing procedures. For a two semester sequence of courses, this could perhaps be handled by rotating different interested faculty as course instructors during the first semester, when the experiments are conceived and the RGSFOP proposals are developed. Technical guidance could be sought from faculty in
disciplines outside that of the current course instructor where needed. Then, the course instructor(s) for the spring term would be assigned based on the specific technical topic areas for those proposals that were actually accepted by the RSGSFOP. In any event, the enthusiastic participation of the instructor(s) is a key contributor to success.

Fourth, we feel that these Microgravity Research Team project courses have added to the “space” content of our Aerospace Engineering curriculum at WVU. The WVU undergraduate Aerospace Engineering program has a heavier emphasis on aeronautical engineering than actual aerospace engineering.

Fifth, one limitation to participation in the NASA RGSFOP is the reduced numbers of student teams that are presently accepted by NASA for flight aboard the C-9 aircraft relative to the peak numbers (72 and 69 teams) in 2003-04. This increased competitiveness of the RGSFOP proposal process makes it more difficult for teams to be accepted into the program. It appears wise for course instructors or team advisors to form some sort of alternate plan in case the team’s proposal is not accepted. One option is to revise and resubmit a failed RGSFOP proposal to the Zero-G Corporation, but this is even more expensive than participation in the NASA program. The Purdue program has developed an in-house one second drop tower that is available for student use; this allows their teams the opportunity to gather some preliminary microgravity data to strengthen their proposals, as well as an option to complete an experiment and obtain microgravity data even if a proposal is not selected by NASA for flight aboard the C-9 microgravity aircraft.

Other more minor lessons learned include a recommendation that the experiment be size and weight limited, if possible, to be small enough to fit the UPS shipping limitations. Otherwise, depending on the location of the university, it may be cost effective to simply drive the experiment to NASA JSC Ellington Field in Houston. This also is the only easy way that we have found to control the date that the experiment arrives at Ellington Field. The tours at NASA JSC are an extremely valuable experience for the team members. We also have made contact with several WVU alumni who have arranged additional tours and social events; these are both enjoyable for the students, and valuable in the development of their interpersonal skills. Finally, while it seems certain that students with good practical and hands on skills are crucial to project success, it also seems that for development of the experimental concept and a successful RGSFOP proposal, high academic achievers with good math/theory skills and writing abilities are crucial. So, a team comprised of students with strengths in both areas is needed. And, since the construction doesn’t happen unless a successful proposal is written first, it is better to err on the side of more theoreticians than more practical types.

To date, we have not conducted any formal surveys or data gathering on the outcomes of our Microgravity Research Team projects. All we have to offer is a body of anecdotal evidence of the program’s benefits to the student participants. We note that student participants nationally often will describe themselves as “RGSFOP alumni” on their Facebook or MySpace profiles, an indication of their view of this being a significant accomplishment. Student comments at WVU about their participation in the MRT projects in course evaluations have been uniformly positive. We feel we have observed significant personal development of almost every student participant, especially in terms of their improved self confidence, communications skills, and independence. The A student in lecture
classes from the back row of the classroom who never said “boo” suddenly develops into the most vocal, effective proponent of participation in the MRT program. Students who have never flown on a commercial flight travel to Houston and participate in the entire RGSFOP experience, and return to campus with a greater self confidence, energized to more aggressively pursue their professional careers. They experience a world of opportunity around them that we cannot show them as dramatically here on campus, and they respond to this experience. Program participants have moved on to successful careers in aerospace engineering. Some have gone on to graduate school; two former MRT3 team members in particular have completed graduate degrees at WVU, working on spray cooling and continuing their reduced gravity flights through collaboration with a team of thermal researchers at the Air Force Research Laboratory in Dayton, Ohio. From this information, we are convinced that students’ participation in the NASA RGSFOP is extremely beneficial to both their personal and professional development. Here at WVU, among the students who have participated in these three project courses are at least 20 WV NASA Space Grant Scholars or Fellows, two Goldwater Scholarship recipients, two former WVU Student Body Presidents, one McNair Scholar, and one SURE summer intern. Many team members have had summer internships at NASA centers; these students have uniformly performed well. Five students have presented posters at the annual Undergraduate Research Day at the Capitol, and eight teams have presented talks or posters at annual meetings of the West Virginia Academy of Science. Five research papers have been presented at national research meetings in Cleveland, Ohio, Miami, Florida, and Toronto, Canada.

Conclusions

A Microgravity Research Team (MRT) project course has been offered over the past eight years at West Virginia University. Each year the student team develops a concept for a unique experiment to be conducted at Ellington Field at NASA JSC in the reduced gravity environment of the NASA microgravity research aircraft. A detailed technical proposal is submitted to the NASA Reduced Gravity Student Flight Opportunities Program (RGSFOP). Once the proposal is accepted, students perform the detailed experiment design, construction, testing, and iterative improvements necessary to ensure a successful experiment. The completed experiments are then flown, data is analyzed, and the results are reported, both in the required NASA final report, as well as in presentations at professional technical meetings.

To date, six successful experiments have been flown by WVU student teams, with a seventh team scheduled to fly their experiment this June. These experiments have been summarized herein, as has the development and present format of the WVU MRT project course.

Acknowledgement

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