

## ***Green Bank Middle School Science Students Continue to Aim High***

For the last three years, students in the 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> Grade science classes at the Green Bank Elementary-Middle School (GBEMS) have participated in special projects with members of the Eight Rivers Amateur Radio Club. Beginning in 2021 with a conversation with astronaut Mark Vande Hei on the ISS via ham radio as part of the ARISS program<sup>1</sup>, to the recent launch of a high-altitude balloon, students, school administration, teachers, and volunteers have planned and executed multiple science and technology related projects.

On March 30, 2023, the middle school science class hosted the entire GBEMS student body for the launch of a high-altitude balloon. The planned objective was to reach the stratosphere and return safely to earth. On board the craft were four cameras, a data acquisition and storage computer, and several student-designed experiments to see how extremely low temperatures and air pressure affected the items on the flight. The flight plan was formulated to reach 100,000 ft at which point the helium filled balloon would pop and the payload package would fall back to earth, slowed in the last minutes of flight by a parachute for a soft landing.



In the course of preparing experiments for the flight, Angela Damery and Sarah Olivera from the Green Bank Science Center brought a dewar of liquid nitrogen to the school and conducted a series of classroom presentation of cold temperatures and their effects on air pressure. This helped the students consider what experiments to conduct in the stratosphere and predict what might be the results. Experiments included various sizes of bubble wrap, water, packing peanuts, marshmallows, popcorn, and even potato chips to see what would happen when exposed to the stratosphere. To maximize the environmental exposure, most of the experiments were mounted to the exterior of the payload box, that itself was an experiment to see if they would

survive the flight.



*Payload package ready for flight.*

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<sup>1</sup> <https://www.youtube.com/watch?v=aZEIXlwzC0c&t=5s&pp=ygUVZ3JlZW4gYmFuayBzY2hvb2wgaXNz>

Meanwhile inside the payload box, a Raspberry Pi computer, outfitted with additional environmental sensors recorded temperature, pressure, GPS-derived location, flight forces, and video of internal experiments. A second SPOT™ tracker determined the location of the payload and reported periodically to a web site via the Globalstar satellite system. A low-power VHF transmitter sent out a tone that students used to track the balloon long after it was far out of sight. All of this was housed in a small Styrofoam box which along with the parachute and an aircraft radar reflector comprised the payload.

After a minor scare when an unexpected last minute wind gust swept the otherwise calm launch site, the entire GBEMS student body counted down to launch and the balloon soared off into the air. Climbing at about 5m/sec, it was soon out of sight and only the radio trackers gave any indication of its direction. Based on flight prediction software from <https://predict.sondehub.org/> a chase team was prepositioned about 120 miles downrange for recovery. To stay in contact between the launch site and chase team a combination of VHF repeaters, EchoLink™, and later, cellular phones were utilized. Using the GPS and VHF radio trackers the team found the payload intact but high up in some trees. Luckily a strong wind the following day freed the payload, and it was successfully recovered.



*Launch!*



*View of the launch site from the external on-board camera shortly after launch. The Green Bank Telescope is in the background.*



*Balloon pop.*



*Landed (almost).*

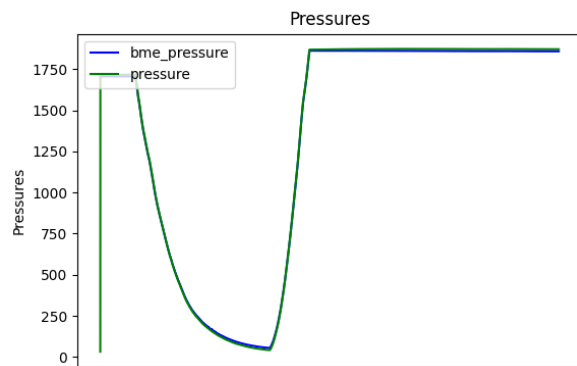
Other than some lost video due to fickle cameras everything survived the flight in excellent condition. Student and volunteer teams are processing the Raspberry Pi data and students are evaluating their experiments. Our initial calculations show we exceeded 90,000 ft for the flight and some terrific video was obtained for the entire flight.



*Outboard camera view at maximum flight altitude.*



*Recovered payload, parachute, and aircraft radar reflector.*



*Atmospheric pressure recorded over the course of the flight.*

It takes a lot of people to coordinate and execute such a flight. A special thank you to Principal Aldersman, Lori Wayne, and science teacher Ms. Bell at the GBEMS, volunteers from the Green Bank Observatory, and the local Green Bank community volunteers for all their assistance and support. We want to thank our sponsors: Green Bank Observatory, GBEMS PTO, Durbin Lions Club, Art in Green Bank, and the Snowshoe Foundation for their financial support of the program.

Photo Credits: Jan Cozak, Green Bank Balloon Project, Rudy Marrujo, Angela Damery