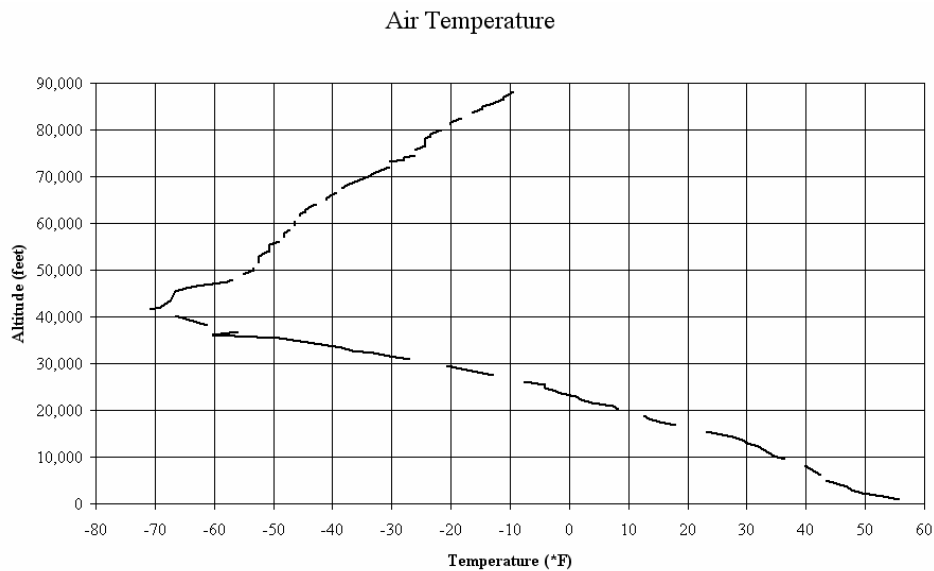


# Near Space

## The Ultimate STEM Experience



Your Students Can Take Pictures Like This...



...and Collect Data Like This.

NearSys LLC is ready to help you and your students design, test, and fly experiments in the unique space-like environment found in near space. That help includes science and engineering kits, lessons, and launch and mission support. NearSys LLC will even help find funding to lower costs.

**It really is a poorman's space program  
Amateur Radio Operator Pete Sias, Salina, KS**

**Thank you for the help you provided to us for our near space satellite. Without your contribution, we would not have been able to learn as efficiently. We are very interested in the data now, and we probably wouldn't care as much about it if we didn't work so hard on this project. Thank you very much for your contribution to our learning.**

**Students from Three Rivers HomeLink, Richland, WA.**

**In terms of how well the kids are doing in science, here is one thing I can tell you. I have observed several kids that I teach, that are also in Satellites, exhibit more confidence in class when we are discussing inquiry processes, hypothesis, variables, and validity/procedure. The 7th graders especially seem to have more knowledge compared to the other students (at least mastered knowledge with less need to remind them of specifics) about those factors. I have heard a few comments such as "we did that in Satellite Club", or "we had to change our procedure or design in satellite club". I have also seen they seem to be able to reason out why some lab in class may not have worked and they tend to include human error in terms of set up or design more often.**

**Teacher Karen Barkley, Bellevue School District, WA**

**Near Space** is the region of Earth's atmosphere located between 60,000 and 328,000 feet. While near space is higher than aircraft traditionally travel, it's a region easily accessed with weather balloons and amateur radio. Conditions here are extreme to say the least. In near space, the air pressure drops below 3% of the average sea level air pressure (or better than 97% of a vacuum). As a result of this near vacuum, the sky changes from its familiar blue into the blackness of space. The air temperature reaches a low of -60° F during the summer and -90° F during the winter. The flux of cosmic rays, subatomic particles from beyond the solar system, increases by a factor of ten or more as the Balloon climbs to 60,000 feet. The horizon's distance increases from three miles at Earth's surface to greater than 350 miles in near space. This increased distance to the horizon makes the curvature of Earth noticeable in photographs.

The remoteness and unique set of environmental conditions found in near space makes its exploration a unique STEM experience, one unlike any other classroom activity. Its easy access and affordability makes near space exploration a practical activity for many science classrooms and science clubs.

### **Near Space Exploration, a Unique STEM Experience**

**Science:** Students fly open-ended inquiry experiments inside of functional models of satellites called **BalloonSats**. Examples of the experiments found in BalloonSats include measuring air temperature, light intensity, sound transmission, sky color, cosmic rays, and relative humidity. In addition, students can perform exposure experiments to determine how items like seeds and toys react or continue to function in the near space environment.

**Technology:** Electronics, programmable dataloggers called flight computers, spreadsheets, and web applications are just some of the examples of the technology that goes into a BalloonSat and its mission. While designing, assembling, and testing a BalloonSat, students learn about sensor design, electronics, and programming flight computers in BASIC. PC software is integral to the programming of a BalloonSat and the analysis of its near space data.

**Engineering:** The BalloonSat is an example of practical engineering. Because BalloonSat airframes consist of Styrofoam, nuts and bolts, hot glue, and colored tape, students can create them using simple hand tools. The design process however is challenging, as students must develop their BalloonSat under strict limits of weight, size, function, and operation. Only after performing engineering tests to verify that their model satellite functions as designed is the BalloonSat ready to fly.

**Mathematics:** Converting a BalloonSat's raw sensor data into environmental measurements is a meaningful application of mathematics. Additional mathematical processing creates graphs showing how conditions change in this environment that the students cannot personally visit.

### **Near Space Exploration, a Practical School Activity**

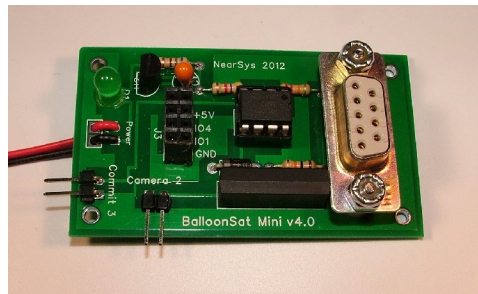
Near space experiments are substantial lab activities in which students build, test, fly, and analyze the data of a BalloonSat. Typically, students will complete the entire project within a single semester. A week prior to launch, students begin predicting the flight path of their BalloonSat mission using online applications and data from the National Weather Service. The actual near space mission itself typically takes three hours. This includes 30 minutes for prep and launch, 90 minutes for ascent, and 45 minutes for descent. The actual time to recover the BalloonSat depends on the location and terrain of the recovery zone (which students will predict ahead of time). Classrooms can monitor the entire mission of their BalloonSat online and with amateur radio. In addition, students can participate in the launch, chase, and recovery of their BalloonSat. Attending the launch of their BalloonSat creates much greater impact and personal satisfaction.

## Reach for Near Space

NearSys LLC makes BalloonSat kits for educational and hobby purposes. These kits are available individually or in complete kits. In addition, NearSys is ready to help educational groups prepare and carry out near space missions. Data and images from past flights are available online for free at [NearSys.com](http://NearSys.com) under the Amateur Radio High Altitude Ballooning link and then Data from Past Flights link.

## Flight Computers

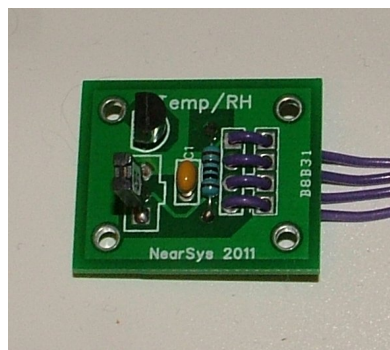
The BalloonSat Mini is a programmable flight computer for two sensors and camera. It's ideal for the first BalloonSat project. Since the BalloonSat Mini has the PICAXE-08M2 microcontroller at its heart, it's inexpensive and easy to program (in BASIC). The BalloonSat Mini is available in kit form that students find easy to solder together. It has enough memory to collect 256 readings from two sensors, which is sufficient memory for sensor readings every 1,000 feet for the entire BalloonSat ascent. The flight program triggers a camera to record images as often as the student desires.



**The BalloonSat Mini Flight Computer**

## Sensors

Three different sensor arrays are currently available from NearSys and they connect directly to the BalloonSat Mini. The arrays include a two temperature sensor array, a temperature and relative humidity array, and a temperature and light intensity array. The sensor arrays produce voltages proportional to the environmental condition that they measure, so it's easy for students to create spreadsheet programs that analyze the results of the mission. In addition, parts and help are available to connect an Aware Electronics geiger counter so that students can measure cosmic rays.



**A Temperature and Relative Humidity Sensor Array**

### **Complete BalloonSat Kits**

Classrooms without multimeters, soldering irons, and other electronics tools can purchase them as a kit from NearSys. BalloonSat kits have all the necessary plastic parts including precut Styrofoam sheets, nuts and bolts, colored tape, and hot glue gun to make a complete BalloonSat. Since the complete kits come with three sensor arrays, students can reconfigure their BalloonSat for multiple missions.



**The BalloonSat kit, containing all the parts and tools required to make a BalloonSat**

### **Helping Classrooms make BalloonSats**

NearSys provides Power Points and assembly directions for all its products. Teachers will find these helpful when building, programming, and testing a BalloonSat. In addition to online help, NearSys provides help through email and personal visits. NearSys can even arrange for onsite presentations and workshops given sufficient notice.

### **Near Space Launch, Tracking, and Recovery Help and Services**

A successful near space launch requires balloon-filling equipment and amateur radio tracking support. Interested groups can construct these items themselves as part of a complete near space program or NearSys can provide the launch and tracking services for groups. NearSys LLC launches will either take place near the Treasure Valley or when possible, at the school's location so students can become more involved.

### **Contact NearSys LLC**

With over 130 flights, NearSys is ready and able to support near space missions. Please contact us at [nearsys@gmail.com](mailto:nearsys@gmail.com) or visit our website, [NearSys.com](http://NearSys.com).

Data from past flights is under the **Amateur Radio High Altitude Ballooning** link, then the **Data from Past Flights** links.

Products are located under the **Catalog of NearSys Products** link, and then the links under the **BalloonSats and Rocket Satellites** section.

Onwards and Upwards