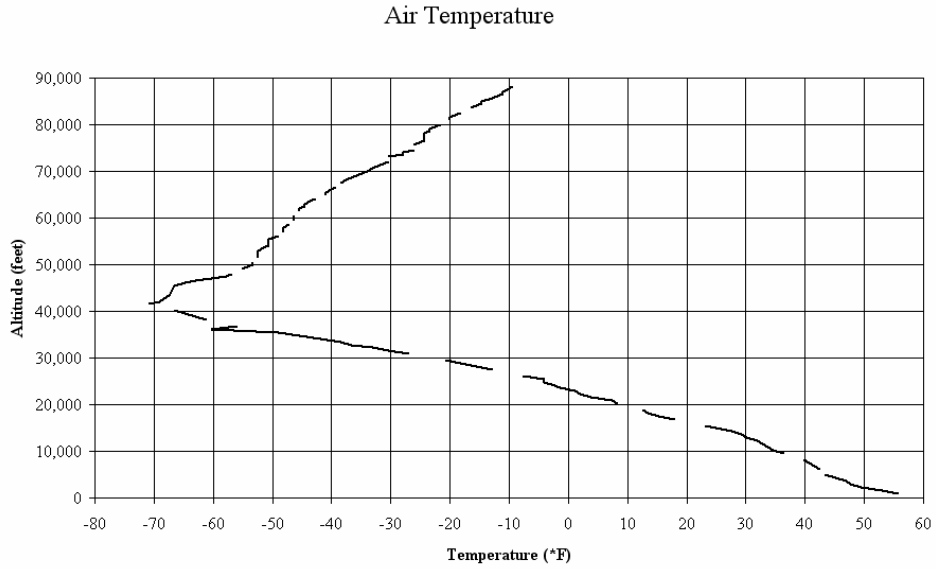
Near Space

The Complete STEM Experience

Your Students Can Take Pictures Like This…

…and Collect Data Like This.



NearSys LLC will 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 can even help find funding to lower your cost.

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

Near Space is the region of Earth's atmosphere located between 60,000 and 328,000 feet above mean sea level. While this space-like environment is above the flight of aircraft, it's a region accessible by weather balloon. Conditions in near space are extreme, to ay the least. The air pressure drops below 3% of the air pressure at sea level. 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^{O}F in the summer and -90^{O}F in the winter. The flux of cosmic rays, subatomic particles form beyond the solar system, increases by a factor of 50 or more as t he balloon approaches 60,000 feet. The horizon's distance increases from three miles at launch to over 350 miles at peak altitude. This increased distance to the horizon makes Earth's curvature visible in photographs.

The remoteness and unique set of conditions found in near space make near space exploration a STEM experience unlike any other classroom activity. And the affordability and ease of near space exploration makes it a practical activity for many science classrooms and science clubs.

Near Space Exploration, a Unique STEM Activity

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 technology that goes into a BalloonSat. 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: BalloonSats are examples 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 raw the BalloonSat's data into meaningful measurements is a meaningful application of mathematics. Students convert the binary data stored in their BalloonSat back into sensor voltages and then into true sensor values using spreadsheet mathematical functions. The resulting graphs show conditions change in an environment that the students cannot personally visit.

The Near Space Environment

The near space environment is extreme compared to conditions found on the surface of Earth. During the approach to 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 the near vacuum found at 90,000 feet, the sky changes from its familiar blue into the blackness of space. The air temperature reaches a low of -60^{o} F during the summer and -90^{o} F during the winter. Near space is dry, the relative humidity drops to 10% or lower. The flux of cosmic rays, subatomic particles from beyond the solar system, increases by a factor of ten or more as a BalloonSat rises to 60,000 feet. The horizon's distance increases from three miles at Earth's surface to 300 to 400 miles away in near space. This great distance to the horizon makes the curvature of the horizon noticeable in photographs. Near space looks and feels like space, but it's accessible for far less money and time.

Near Space Exploration is a Practical School Activity

Near space experiments are extended 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

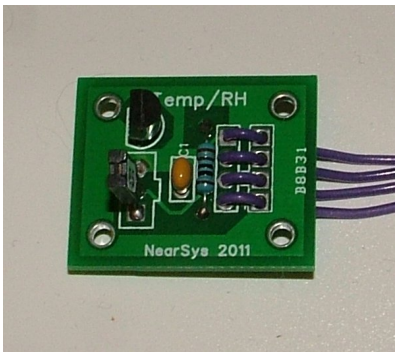
Service. The actual near space mission itself typically takes three hours. This includes 30 minutes for prep and launch, 90 minutes for ascent, and 45 minutes for descent. The actual time to recover the BalloonSat depends on the location and terrain of the recovery zone (which students will predict ahead 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. Being able to attend the launch of their BalloonSat creates much greater impact and personal satisfaction.

Reaching Near Space
NearSys LLC makes BalloonSat kits for educational and hobby purposes. These kits are available as single items or complete kits as explained below. In addition, NearSys is excited to help educational groups prepare and carry out a near space mission. Data and images from past flights are available online for free.

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 a PICAXE-08M2 microcontroller at its heart, it is 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 reading from two sensors, which is sufficient to make sensor readings every 1,000 feet for the entire BalloonSat ascent. The flight program triggers a camera to record images as often as students desire.

The BalloonSat Mini Flight Computer

Sensors
Three different sensor arrays are 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 to the BalloonSat flight computer.



A Temperature and Relative Humidity Sensor Array

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

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

Help with making BalloonSats
The NearSys website has 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 with personal visits. NearSys can even arrange for onsite presentations and workshops with 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 in or near the Treasure Valley or when possible, close to the customer's location so that students are involved.

Contact NearSys
With over 136 flights, NearSys is ready and able to provide support for near space missions. Please contact us at nearsys@gmail.com or visit our website, 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.