LESSON 6: UP, UP, AND AWAY IN MY BEAUTIFUL BALLOON

There is a video of a weather balloon launch done by two Seattle girls, ages 8 and 10 years old. Find the video here: http://www.geekwire.com/2015/two-seattle-girls-launched-a-balloon-to-the-edge-of-space-this-weekend- and-have-the-video-to-prove

The balloon was equipped with 2 video cameras and a GPS tracking device. With help from their parents, the girls filled the balloon with helium and launched it. It was able to reach a distance of 78,000 feet above the earth.

GRADES K-2

After watching the video of Kimberly and Rebecca's balloon launch, read aloud a book about a balloon trip. Eleanor Coerr's, *The Big Balloon Race*, is based on the true story of a hydrogen balloon race and a real ballooning family in the late 1800s.

Teachers may choose to discuss the differences between helium balloons, hydrogen balloons, and hot air balloons. The class may also enjoy watching some of the videos from hot air balloon rallies that may be found on YouTube.

GRADES 3-5

After watching the video of Kimberly and Rebecca's balloon launch, read aloud a book about a balloon trip. Marjorie Priceman's, *Hot Air: The (Mostly) True Story of the First Hot-Air Balloon Ride*, is based on the true story of a hot-air balloon launched in 1783 by the Montgolfier brothers with a duck, a sheep, and a rooster on board as the first passengers.

Teachers may choose to discuss the differences between helium balloons, hydrogen balloons, and hot air balloons. The class may also enjoy watching some of the videos from hot air balloon rallies that may be found on YouTube, or researching more about the Montgolfier brothers and other balloon pioneers.

GRADES 6-8

After watching the video of Kimberly and Rebecca's balloon launch, teachers may choose to discuss the differences between helium balloons, hydrogen balloons, and hot air balloons. The class may also enjoy watching some of the videos from hot air balloon rallies that may be found on YouTube.

For a more hands-on approach, follow the directions from NASA on how to stage a hot- air demonstration using only a dry cleaning bag, a hair dryer, and some paper clips. Find the file here:

http://www.grc.nasa.gov/WWW/k-12/TRC/Aeronautics/Hot_Air_Balloon.html

If you have the support of an art teacher (or extra time in a STEM or Science Club), you may wish to have the students assemble their own hot-air balloons from tissue paper. Find more information here:

http://www.balloonexplorium.org/index.php?page=tissue-paper-balloons

These and other balloon related activities and resources may all be found on the Civil Air Patrol's site at:

http://ae.capmembers.com/curriculum/lessons__activity_resources/hot-air-balloons/

GRADES 9-12

The article says that the actual flight path is considerably longer than the projected flight path and traces the cause back to an error in the weight of the payload. The payload was heavier than the girls had calculated that it would be; intuitively one would think that a heavier payload would cause a shorter flight path, but this was not the case. It may be helpful to work through the chain of reasoning that leads from a heavier payload to a longer flight path. Usually when one considers weight and path length, one is heaving the load with force main; in the case of the balloon, though, the balloon is lifting the payload because of its buoyancy.

A heavier payload means that there is less net buoyancy and therefore a smaller net upward force on the balloon as a whole. The smaller net force is more easily counteracted by aerodynamic drag, causing the balloon to rise more slowly. The slower rise of the balloon gives it more time to be blown along its horizontal path by the wind, which leads to a longer flight path. The balloon burst at the same altitude as it was predicted to.

The shape of the actual flight path is almost the same as the shape of the predicted flight path. This is because the direction of the wind depends most strongly on the altitude. The balloon spent proportionally about the same amount of time at each altitude as it was predicted to; thus the relative proportions of the different parts of the flight path are about the same.

This is not a unique accomplishment; many other young people (with help from older people) have also sent cameras and small payloads up to the upper atmosphere. Here are some examples:

- http://www.nasa.gov/centers/glenn/technology/explorers_balloons.html
- http://www.dailymail.co.uk/sciencetech/article-2649692/Thats-world-Homemade-helium-space-balloon-captures-breathtaking-images-Scottish-highlands.html
- http://www.space.com/19740-girl-sends-hello-kitty-into-stratosphere.html
- http://www.gizmag.com/father-and-son-send-camera-to-outer-space/16650/