**Potential weather balloon curriculum connections:**

**Math**

* If the weather balloon is initially filled with a volume of 50 ft3 of helium gas (He), what will the balloon’s diameter be? How does this diameter compare with your arm span?
* The weather balloon bursts when the diameter reaches 8ft. What amount of space (volume) will the helium occupy just before the balloon bursts? Find an example of something familiar to you that has a similar volume.
  + - * + Need to know:

Volume of a sphere = 4/3 π r3

**Physical science**

*Pre-launch questions*

* If a weather balloon is filled with helium (He) to an initial diameter of 4 ft at ground level (assume: 760mmHg and 25˚C), how many moles of helium does it contain?
* Once airborne, the weather balloon will burst when its diameter reaches 8’. If the air temperature remained constant, at what atmospheric pressure would the balloon burst?

*Post-launch questions*

* At what altitude did the balloon burst? Compare your predicted altitude to the actual burst altitude. Are there differences? Why?
* Use the temperature and pressure from your weather balloon launch to calculate the actual diameter of the balloon just before it burst. Assume it is filled with the same amount of helium it started with at ground level. How does your calculated value compare with the manufacturer’s burst value? Are there differences? Why?
* What’s the highest altitude your weather balloon reached? How long did it take for your balloon to reach this altitude? What was the average ascent rate (speed it went up) of your weather balloon?
* Plot (on google earth) the approximated flight path of your weather balloon launch. By entering your latitude and longitude, ascent rate, and payload mass, the flight predictor will use average wind speeds at different altitudes to calculate your balloon’s approximate position. How far away from the launch site did your balloon travel before it burst? How long did it take your balloon to burst? Based on the flight path, what is the average horizontal speed (and direction) that your balloon traveled?

Need to know:

* Ideal gas law PV = nRT
* K = 273 + temperature in Celsius
* 760mmHg = 1 atm
* Volume of a sphere = 4/3 π r3
* Air pressure above sea level can be calculated as: *p = 101325 (1 - 2.25577 10-5 h)5.25588*
  + - * + *where* *p = air pressure (Pa)*, *h = altitude above sea level (m)*
        + Alternatively, students could use the air pressure data from a previous launch to extrapolate altitude once they’ve calculated air pressure.

**Engineering**

* Design and build payload and/or parachute
* Learn more about Arduino to program cricket sensor

**Geography**

* Map and track the latitude and longitude of the balloon along its journey
* Use Google Earth as a tool

**Science and society**

* The helium gas used to fill the weather balloon is one of the most costly parts of a weather balloon launch. What is the current price of helium? Why is the price of helium on the rise? What other technologies / industries depend on helium?

**Communication**

* Write an “if found” letter to accompany payload
* Create a scientific presentation to share results
* Write a creative story tracing the balloon’s journey, how conditions changed along the way and where it landed

**Interesting additional links and resources:**

Lego Man in Space video clip (1:30)

Shows video of a “Lego Man” that was attached to a weather balloon on its journey ascending and descending. <http://www.youtube.com/watch?v=MQwLmGR6bPA>

Sigma rockets: How to make a model rocket parachute (4:24)

Short video clip showing how to construct a basic parachute using a plastic trash bag, tape, and string <http://www.sigmarockets.com/blog/2011/06/making-a-model-rocket-parachute/>

Earth The Power of the Planet: Atmosphere (58:55)

Full-length piece narrated by Dr. Iain Stewart that gives a comprehensive overview about the structure, function, composition, and evolution of the atmosphere. The section from 2:20 – 9:40 gives a jet tour of the atmosphere. From 9:40 to12:40 focuses on Joseph Kittenger’s freefall jump on August 16, 1960. Then, from 12:40 - 15:20 the video focuses in on the structure of Earth’s atmosphere beyond the stratosphere.

<https://www.youtube.com/watch?feature=player_embedded&v=J5ViCNJAkHg>

An Introduction to the Arduino (4:24)

Short video gives a broad overview of what Arduino is and what you can do with it.

<http://www.youtube.com/watch?v=CqrQmQqpHXc>