**Lesson Plan (for day-of)**

*Engineering vocabulary:*

* Lift: The upwards force on a body
* Drag: the retarding force on a body
* Trajectory: the path of a projectile
* Control variable: some aspect of your design that COULD be changed, but isn’t being changed during a given test
* Independent variable: the aspect of your design that you are changing in order to test its effect or importance on the dependent variable
* Dependent variable: the thing you measure responding to independent variables; you don’t change it directly

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| **Time** | **Length** | **Description** |
| 3:15pm | ~10-15 min | Introduction: What is aerospace engineering and how cool are rockets, amirite? Include NASA sounding rockets video -- <https://science.nasa.gov/science-news/sciencecasts/nasas-sounding-rockets> |
| 3:30pm | ~ 5 min | **Part 1: Let’s talk about rockets!**  There are three main components of a rocket we want to highlight here, from top to bottom, you have the nose cone, the body, and the fins.  **Questions:** What different purposes do we see from these three components?   * Nose cone makes the rocket more aerodynamic * Body holds the stuff you want to go into space (and the fuel to launch the rocket, usually ~50% or more of the overall rocket size/weight) * Fins provide stability. The easiest way to do this is to provide spin (like throwing a football with a spiral), but people and sensitive components don’t like spinning too much, and as control has improved, we don’t need to spin rockets anymore. |
| 3:35pm-ish | 15 min | **Part 2: Assemble**  With the material that they have, build your rocket. The first thing you’re going to need to do is to cut out all the components. Next, roll the rocket body around a pencil or pen to form it, then tape it together. Third, pinch and twist the top of the rocket body together to make a nose cone. This needs to be pretty air tight, so you might need some tape. Lastly, tape the fins onto the back of the rocket and get ready to launch! |
| 3:50pm-ish | 15 min | **Part 3: Test, iterate, record measurements**  Once your rocket is built, it’s time to test it out! Use the straw to blow the rocket, then measure how far it traveled. Safety first! Make sure to clear the launch pad and test range before you test your rocket.  **Questions:** Think about what might affect your rocket performance. Should your fins be bigger or smaller? Could you add weight to affect the rocket flight? Maybe the length, angle, or other dimensions of the nose cone are impacting performance. Oh, and don’t forget about the launch system: are you using the same force of breath every time? What about the angle of the straw or whether you’re standing or sitting when you launch it?  Engineering takeaways:   * When we test, we want to control the non-tested elements as much as possible. So, try to change only one thing at a time and see what improves. * Plotting helps visualize what’s happening. Think about changing just one variable and representing how your goal (distance flown) changes with that one variable (so, we could imagine changing launch angle).   Give students additional 10 minutes to incorporate changes. |
| 4:05pm-ish | 5 min | Bring everyone together, have students share designs / strategies |
| 4:10pm | 5 min | Final questions, closing thoughts |

**Soda straw rockets**

(lesson adapted from <https://www.jpl.nasa.gov/edu/teach/activity/straw-rocket/>)

The goal of this lesson is for students to design and build the rocket that will fly the furthest and figure out how different aerospace principles affect flight.

**Materials:**

* Print out of template here: <https://www.jpl.nasa.gov/edu/pdfs/strawrocket_worksheet.pdf> or make a 5 ⅛” x 1 ⅜” rocket body + two fins with tabs
* Pencil
* Tape
* 1 straw (a couple of straws in case of catastrophic straw failure?)
* Scissors
* Paper clips (not necessary, but fun to test changing the weight of your rocket)

**Lesson plan (see above)**