Anne Jolly's Analysis of the Touchdown Challenge

Specification by Specification

Here's my personal take on this lesson. I consider it a really cool idea – especially for a space unit. Your take might be different, and that's okay. This analysis of this lesson will be the longest and take you the deepest into analyzing a lesson. Now grab your 11 Specifications summary and let's begin.

For Specifications 1, 2, and 3: I give this lesson a thumbs up ("Yes" rating). The problem is real, compelling, and kids can relate to it. There are multiple acceptable solutions that they could design. I might make an adaptation based on the 8th graders I've taught. For one thing, I'd explain how shock absorbers work, but I'd avoid giving students information about how to fold the index card into a spring to create shock absorbers, except on an as-needed basis. Make them think! I'd simply give teams the materials and let kids muck about with them to invent ways to use them as shock-absorbers. (They'll figure it out.) If a team is completely stuck or off track, you could give them some hints and idea starters, of course.

For Specification 4: I rate this lesson "Somewhat "on applying important science and math concepts. There's little explicit focus on grade-level content. Although you can find some reference to it in the discussion section, content is not made explicit to the students as the lesson is conducted. If I decide to use this activity, I'd match it with appropriate science objectives (e.g. gravity, force and motion, potential and kinetic energy, Newton's Laws). Next, I'd decide on places in the lesson when students need to use what they've learned about gravity, force, and other science concepts related to the activity. Then I'd make these content applications explicit during the activity.

I'd also make sure appropriate math objectives are included. Maybe kids could create scatter plots or Cartesian graphs with the data. Note that the Extensions section offers ample opportunities for students to collect and use data to do a number of calculations and comparisons.

For Specification 5: I give the lesson a "Somewhat" as well. Parts of the engineering design process are definitely visible in the Engineering Design Rubric in the Assessment section. (Note that it misses a few steps normally included at a middle school level, but it includes some basic ones.) However, notice that the EDP and the steps are not directly referenced with students during the lesson, although some are clearly visible as headings in the student handout.

To help students develop a consistent way of approaching engineering problems, I would be certain the students recognize and understand the connections between what they are doing and the engineering design process. (Chapter 8: *The Engineering Design Process* gives you a look at the EDP this book recommends.) In addition, since research is not a part of this lesson, I'd be sure that one or more subsequent STEM lessons do involve the kids in research so they can make informed decisions about possible solutions. I might invite teams to research uses for shock absorbers or the nature of moon landings to possibly spur interest. Or even involve kids in testing something like what number of card folds works best as a shock absorber before choosing a design to use in their final prototype.

For Specifications 6 and 7: I give this lesson a definite "Yes." Students are engaged in hands-on learning (although the instructions are overly directive, in my opinion). Teams are also designing and developing prototypes to solve a real-world engineering challenge.

For Specification 8: I vote "No." Computers and digital technologies were not mentioned in the lesson. Students could use computer spreadsheets to keep a record of results. Or they could communicate about their lesson online. I'd check with a technology teacher and find out if she can help me authentically incorporate digital technology in the activity. Lots of apps purport to teach about force and motion, as well as energy. One of those might provide great opportunities for fun and research for students if they have access to digital technology.

For Specification 9: I give the lesson a definite "No." Students are never directed to work in teams and teams are never mentioned in the lesson. I'd definitely add this to the lesson plan and decide on a life and leadership skill, such as being responsible or actively participating, for students to practice during this lesson. See Chapter 12 for suggestions on skills to include.

For Specification 10: I'd give a "Yes" for individual testing. But I'd make some adjustments. Nowhere during the lesson are any criteria provided to students that the shock-absorbing system should meet. Nor were any constraints specified. Those are a must!

- For *criteria* I would include things like: The cabin must be able to remain upright when dropped from 30 cm; astronauts must not fall out, etc. As a variation, perhaps students could drop the cabin from a number of different specified heights and see how the prototype performed at each height. I might ask teams to make a graph of the relationship between the height from which their cabin fell and its success in preventing the astronauts from falling out.
- One *constraint* might be that teams can use only the materials provided. Or, if you put out additional materials to give students a wider selection, perhaps a constraint would state that they can use only "X" number of materials to construct the prototype.

I also think it would be useful for teams to determine how their prototype's performance compares to prototypes constructed by others. Perhaps they could determine which of the cabins they've created could be safely dropped from the highest point. All teams could then include the best features of other teams' prototypes in their redesigns and do another trial run.

For Specification 11: I vote "No." Nowhere does this lesson suggest ways kids can communicate ideas and information within their teams, with others in the classroom, schoolwide, or in their community. Additional types of communication could be added, such as taking pictures or making short videos and designing a presentation or posting news about their spacecraft online.

Reflecting On The Touchdown Lesson Analysis Results

Hmmm. This lesson didn't get a "Yes" on every criteria. What now?

No problem! Remember, every STEM lesson does *not* need to meet every lesson specification. Often your lessons are limited by time. Notice that this is designed as a 60-minute lesson. If you add criteria and constraints (as you must if kids are to do controlled testing) and teamwork; nail down the connections with science and math content; and then make needed adaptations for kids to create their own designs, test prototypes, collect data and evaluate prototypes according to the criteria, discuss results, and creatively communicate with others, then you probably want to plan for *at least* a two-day lesson.

Good, basic lessons such as this allow you plenty of freedom to adjust the particulars for your students and their needs. You'll notice that I mentioned some adaptations I'd make in the lesson for my students. Just be aware that *all* STEM lessons should focus on as many specifications as possible.

One final note on this lesson – and this is definitely a personal preference – *I generally avoid setting up STEM lessons as competitions between teams.* I'd rather the team members share ideas and learn to work together as they will need to do in future jobs. So, for my students, I would not set this up as a competition: I'd stage it as a collaboration to meet a client or specific company need – as NASA engineers might do – drawing on the best of everyone's work.

I'd definitely rate this lesson as a "keeper" with any needed modifications to tailor it for your students and your STEM needs.

Source: See the *STEM by Design* (2025) book website at More Resources / Evaluating and Adapting an Existing Lesson as a STEM Project.