# Problem Definition Worksheet
## Educator Guide



**Design Challenge: Design a Rechargeable Device with a Safe Battery Enclosure**

In the Science of Thermal Runaway pathway, students learn about specific risks that could cause a lithium-ion battery to enter thermal runaway. They can use their understandings of those risks to write a complete problem statement about the engineering challenge of designing safe battery enclosures and devices.

Students choose a rechargeable device to design, and define the design problems that their teams will need to consider as they design the device. The student version of this worksheet includes blank spaces. On this educator version, those spaces are filled out in blue with example responses. Students may fill out their worksheets as they progress through the pathway, prompted by the problem definition questions at the bottom of each driving question page. Or, they may fill out their worksheets at the conclusion of the pathway. Either way, this can lead into the Engineering Design Challenge.

We as Clever Group Name (safety engineering team name) will design a safer space for a(n) computer, phone, e-bike, drone, drill, earbud, etc. (device) Li-ion battery

to minimize excess electrical energy to thermal energy discharge, etc. (unwanted energy change(s)) during charging and discharging,

protecting the battery from external damage caused by dropping, puncturing, crushing, collisions, hammering, etc. (possible damage to your device),

with the appropriate charger to avoid overcharging, mismatched voltage and amperage, etc. (risk(s) from mismatched chargers)

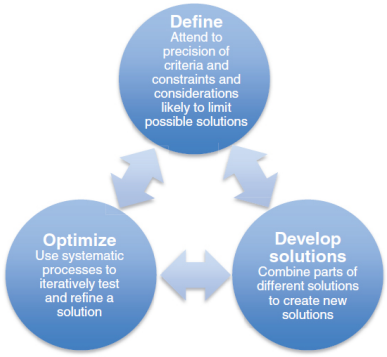
which could lead to thermal runaway, and preventing the spread of thermal runaway by

avoiding excessive internal or external temperatures, combustion, explosions, projectiles, etc. (risk(s) causing cell-to-cell thermal runaway spread).

**Next Steps**

Now that students have defined the problem, they may develop solutions. Each student in each group can draw (model) a solution idea and label the design's features that mitigate the risks in their problem definition statement. Then, groups should come together to discuss the features each member designed, and choose a combination of features that the whole group agrees are worth testing out.

If there is time, students can test those features through peer or adult critique, or build a physical prototype or proof of concept to test features of the design. For instance, they could test for physical damage effects by dropping or colliding the prototype. Or continue to our Engineering Design Challenge to test for thermal energy safety.




The Engineering Design Process, Grades 6-8[1]

[1]APPENDIX I: Engineering Design in the Next Generation Science Standards." National Research Council. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press. doi: 10.17226/18290 National Academies of Sciences, Engineering, and Medicine. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press. https://doi.org/10.17226/18290.