

Thermal Runaway Engineering Design Challenge (Resource Exchange)

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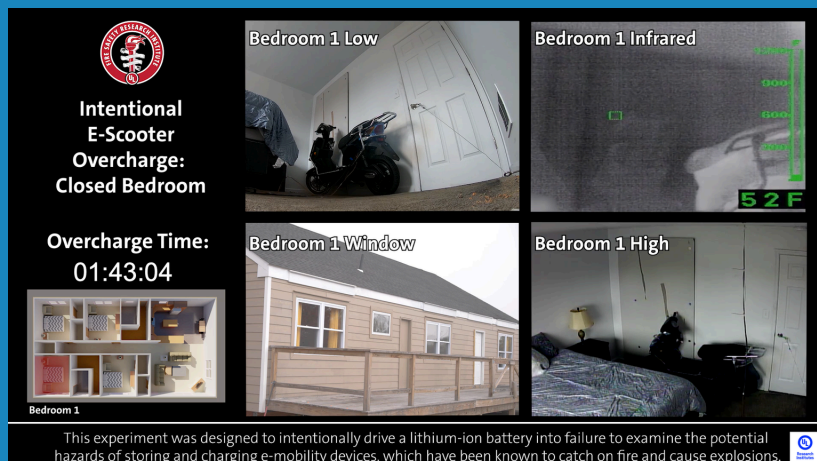
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The Science of Thermal Runaway

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The footage students start with is provided courtesy of UL Research Institute's Fire Safety Research Institute (FSRI). It depicts their actual research quantifying the hazards of thermal runaway in lithium-ion battery-powered e-mobility devices.

What do you observe when researchers intentionally overcharge this scooter?



OVERVIEW OF THE OPEN-ACCESS PATHWAY

Teaching engineering and safety science, especially as an educator without a technical background, can be challenging and overwhelming. Using real research, problem solving pedagogy, and hands-on activities energizes students while giving teachers confidence to teach engineering in classrooms.

Xplorlabs is designed by educators for educators, and is open-access with no cost outside of basic classroom materials for labs.

Students are challenged to take the role as safety engineers, designing and refining a battery enclosure that balances heat retention and dissipation.

Students can build their technical understanding of:

- circuitry and batteries,
- causes of thermal runaway
- how thermal runaway spreads

Science of
Thermal Runaway



Relevant NGSS Standards

- MS-ETS1 Engineering Design
- MS-PS3 Energy
- MS-PS1: Matter and its Interactions



Grade Level Recommendations:
Middle and High School Science/Engineering



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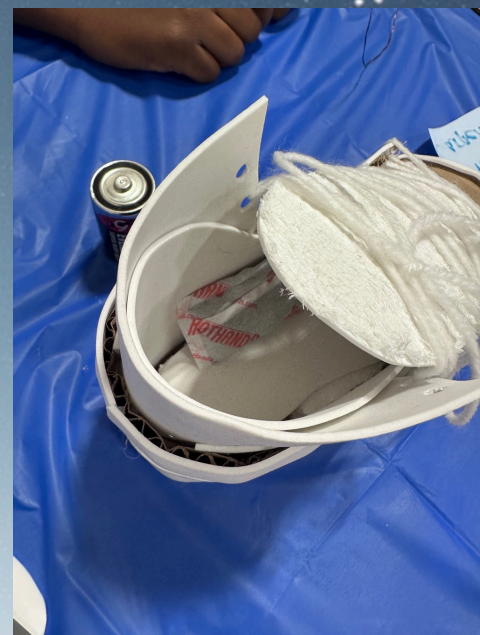
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THERMAL RUNAWAY ENGINEERING DESIGN CHALLENGE:

In this engineering design process, students select, test, and choose a material(s) to use in a battery enclosure to safely manage thermal energy.

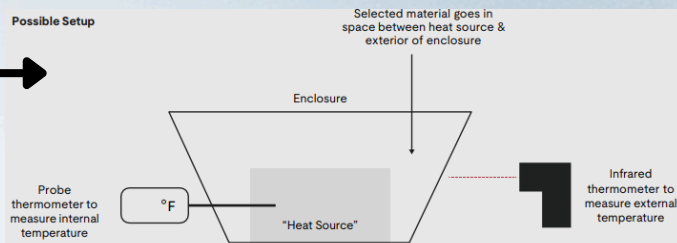
Students engage with criteria and constraints, while taking on real-world engineering roles and building their designs to meet safety standard requirements.

Design Criteria	Constraints	
Minimize risks associated with change in temperature.	The internal temperature of battery enclosure cannot increase more than 5°F (2.8°C)	The external temperature of the battery enclosure cannot increase more than 7°F (3.9°C)
Roles		
The Stuff Supervisor Gather and clean up materials.	The Experiment Exec Ensure reliability of test data	The Director of Documents Help with recording data
		The Presenter Share the group's work with the class



Materials

- Prototype of battery enclosure
- Handwarmers to simulate battery heat
- Temperature probe(s) and infrared thermometer
- Materials for testing thermal performance (insulators and conductors)
 - Water, plastics, papers, clay, cork, foil, etc - use whatever you have!



Sample experimental engineering design setup. This design can be modified by the instructors or by the students to fit what materials are available.

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Platform Information

xplorlabs.org

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Engineering Design Challenge

