XPLORLABS | UL Research Institutes

Problem Definition Worksheet

BRAINSTORM: Throughout the Science of Thermal Runaway pathway, driving questions help to transform your understanding of thermal runaway into a working problem definition. You can use this page to organize your thinking as you prepare to define thermal runaway.

1. How does a lithium-ion battery work?

What unwanted energy changes will you need to consider to make a safe battery enclosure? Name possible energy changes you can predict during charging and discharging and their potential risks.

Potential Hazard	Potential Risk

2. Why are battery-powered devices designed to prevent physical damage?

Some of our rechargeable devices take on a lot of physical damage. Brainstorm three specific hazards for damage a device might face while being used or stored. How could those hazards affect the battery's safety?

Potential Hazard	Potential Risk

3. How does overcharge relate to thermal runaway?

You may have noticed that many devices seem to have the same charging port but come with special chargers. Some consumers don't notice that different chargers have specific uses. What hazards and risks related to overcharge should you be aware of?

Potential Hazard	Potential Risk

4. How does thermal runaway spread?

Different rechargeable devices need different numbers of cells in their batteries or are stored near other battery-powered devices. What potential risks for thermal runaway spread do you need to consider?

Potential Hazard	Potential Risk

DEVELOP:

1. **Initial problem statement:** Use your brainstorming on the previous page and the template below to help you create a problem statement for thermal runaway.

CONSIDERATION	STATEMENT
Thermal runaway	We as _____ (team name) will design a safer space for a _____ (device) Li- ion battery.
Batteries What unwanted energy changes will you need to consider to make a safe battery enclosure?	We will minimize _____ (unwanted energy change) while the battery charges and discharges.
Physical Damage Brainstorm risks for damage the device might face while being used or stored. How could those risks affect the battery?	We will ensure the correct charger is used to avoid _____ (risk from mismatched chargers).
Overcharge What risks of using the wrong charger should you be aware of while you design the charging port?	We will protect the battery from physical damage from _____ (possible damage to device), which could cause thermal runaway.
Spread What potential risks for thermal runaway spread between cells or batteries do you need to consider?	We will prevent the spread of thermal runaway by avoiding _____ (excessive internal or external temperatures, explosions, or projectiles).

1. **Design requirements:** What will determine the **success** of your design?

CRITERIA These are **measurable goals** for your design. Your design should strive to do this more and more.	CONSTRAINTS These are the "musts" for your design: **Mandatory requirements** or limitations.
•	•
•	•
•	•

2. **Refined problem statement:** Below, combine your thinking into one refined statement that expresses your most important goals and indicators for success.

We as _____ (team name) will design a _____ (device) battery enclosure to _____ (your most important design requirements) for _____ (customers/stakeholders).