GRID & SILICON

Parent / teacher guide

Battery Storage: Power Now, Energy for Later

Word help: gridandsilicon.com/glossary/

Quick answer key

Time: about 30–40 minutes. **Materials:** Pencil, student sheet and explainer; extension materials are listed below.

- I can trace energy through battery storage.
- I can use the model to explain a new situation.
- I can explain one limit or tradeoff.

NGSS connections: 4-PS3-2: energy transfer by heat and electrical currents (concept connection). 4-PS3-4: devices converting energy between forms (concept connection; lesson alone does not meet the full design expectation). These are partial teaching connections, not certification.

Warm-up: 1. Charge in · 2. Discharge out

Multiple choice: 1. C · 2. A · 3. C · 4. B · 5. B · 6. A · 7. B · 8. C · 9. A

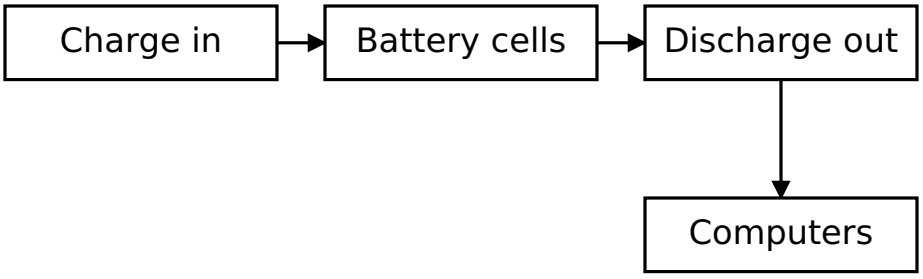
Fill-in: cell · MWh · Charging

Diagram labels, by number: 1. Charge in · 2. Battery cells · 3. Discharge out · 4. Computers

Open responses: accept a clear link between the example and the technology. See the samples below.

The big idea

A rechargeable battery stores supplied energy through changes in its materials. It later delivers that energy through electricity to equipment. Power tells us how fast energy is delivered, while stored energy tells us the amount available. Both matter when asking how long the battery can supply computers.



Words to know

cell: A cell is the basic working unit of a battery. Like one unit in a set of joined building blocks. · electrodes: Electrodes are the cell parts where chemical reactions take place. Like the two working sides of the cell, with different jobs. · electrolyte: Between them is an electrolyte, a material through which charged particles move. Like a special passage that allows certain charged particles through. · Power: Power is how fast energy is delivered or used. Like how fast water flows, rather than the tank's size. · MW / MWh: MW is the power rate. MWh is the stored-energy amount. Like water flow and tank contents.

Question guide

1. A large battery is built from many small working units. What are those units?

C. Cells. Look inside the battery rather than at its outside power equipment.

> **Evidence:** "A cell is the basic working unit of a battery."

Other choices: A: A generator converts motion rather than storing energy chemically. B: A transformer changes voltage rather than acting as a cell.

If stuck: Look inside the battery rather than at its outside power equipment.

2. A diagram marks two surfaces where battery reactions occur. What are they?

A. Electrodes. Distinguish reaction surfaces from outside wiring.

> **Evidence:** "Cells have two electrodes, the parts where chemical changes take place."

Other choices: B: Cooling plates transfer heat rather than hosting battery reactions. C: Outside connectors are not the cell's reaction surfaces.

If stuck: Distinguish reaction surfaces from outside wiring.

3. A wire connection is broken. What must be restored for current to flow?

C. A complete circuit. Trace an unbroken electrical path.

> **Evidence:** "A circuit is a complete path through which electric current can flow."

Other choices: A: More space does not complete the electrical connection. B: A higher rating does not repair the broken path.

If stuck: Trace an unbroken electrical path.

4. A phone is plugged in and its stored charge rises. Which stage is occurring?

B. Charging. Ask whether energy is entering storage or leaving it.

> **Evidence:** "Charging uses incoming electricity to store energy in the battery."

Other choices: A: Discharging sends energy out, not into storage. C: Fuel generation differs from recharging a stored-energy device.

If stuck: Ask whether energy is entering storage or leaving it.

5. A charged battery runs a lamp after its charger is removed. Which stage is occurring?

B. Discharging. The lamp uses energy saved earlier.

> **Evidence:** "Discharging means delivering stored energy to equipment through electricity."

Other choices: A: The lamp uses stored energy, not incoming fuel. C: Charging sends energy in, not to the lamp.

If stuck: The lamp uses energy saved earlier.

6. Computers need power during a brief supply gap. What can a charged battery provide?

A. Stored energy for a limited time. A battery bridges a gap within its stored amount.

> **Evidence:** "Battery systems can support computers during a gap in another supply."

Other choices: B: The battery must be recharged after its store runs down. C: Limited stored energy cannot replace every supply forever.

If stuck: A battery bridges a gap within its stored amount.

7. Which rating tells how much energy a battery stores?

B. MWh. MW is a rate; MWh is an amount.

> **Evidence:** "A megawatt-hour, written MWh, measures stored energy."

Other choices: A: MW states the rate, not the stored amount. C: Hours describe time, not energy stored.

If stuck: MW is a rate; MWh is an amount.

8. A fully charged ideal battery holds 4 MWh and supplies 2 MW. Ignoring losses, how long can it run?

C. 2 hours. Divide stored energy by the rate of use: 4 divided by 2.

> **Evidence:** "Ignoring losses and assuming steady power, running time in hours equals stored MWh divided by MW."

Other choices: A: Multiplying the ratings gives the wrong units for time. B: The taught division gives two hours, not half an hour.

If stuck: Divide stored energy by the rate of use: 4 divided by 2.

9. The same 4 MWh battery supplies 1 MW instead of 2 MW. Ignoring losses, what happens?

A. It lasts twice as long. Using the same amount more slowly increases the time.

> **Evidence:** "If the same stored energy is used faster, it runs out sooner."

Other choices: B: Changing use rate does not double the stored amount. C: A lower use rate increases rather than halves running time.

If stuck: Using the same amount more slowly increases the time.

Warm-ups, vocabulary and labels

Which arrow shows energy entering during charging? Charge in. Which arrow supplies electricity to the computers? Discharge out.

Use the labeled diagram to check each numbered blank. Arrows show the path through this technology.

1. cell — A cell is a battery's basic working unit.

2. MWh — MW measures power, while MWh measures an energy amount.

3. Charging — Charging stores energy supplied by electricity.

Think about it: sample answers

Your phone battery falls faster while you play a game. Explain using energy and power. The game may use energy at a faster rate, so the same stored amount runs out sooner.

You need a lamp during a power cut. What two battery ratings would help you plan? I would ask for usable stored MWh and the power the lamp needs. Then I could estimate the time, allowing for losses.

Look for a correct connection to the new situation, not a memorized sentence.

Common mix-ups

- A cell is a battery's basic working unit.
- MW measures power, while MWh measures an energy amount.
- Charging stores energy supplied by electricity.
- A battery's running time depends on stored energy and use rate.

- A diagram is a simplified model, not a construction plan.

Exit ticket

1. Name one input and one output.
2. Explain what one part does.
3. Predict what changes if a needed input stops.

Check for a valid input/output, the correct job of a named part, and a prediction that follows the energy path.

How to help

Read aloud, pause after one section, and allow a look back at the model. Praise a useful strategy. If frustration grows, take a break and resume with one manageable step.

Safe at-home extension

Use a phone's battery screen to compare two short periods of normal use. Keep brightness similar and note the activity. Discuss why this is not a precise battery-capacity test. Do not open a battery.