



PEEL

People for Energy and
Environmental Literacy

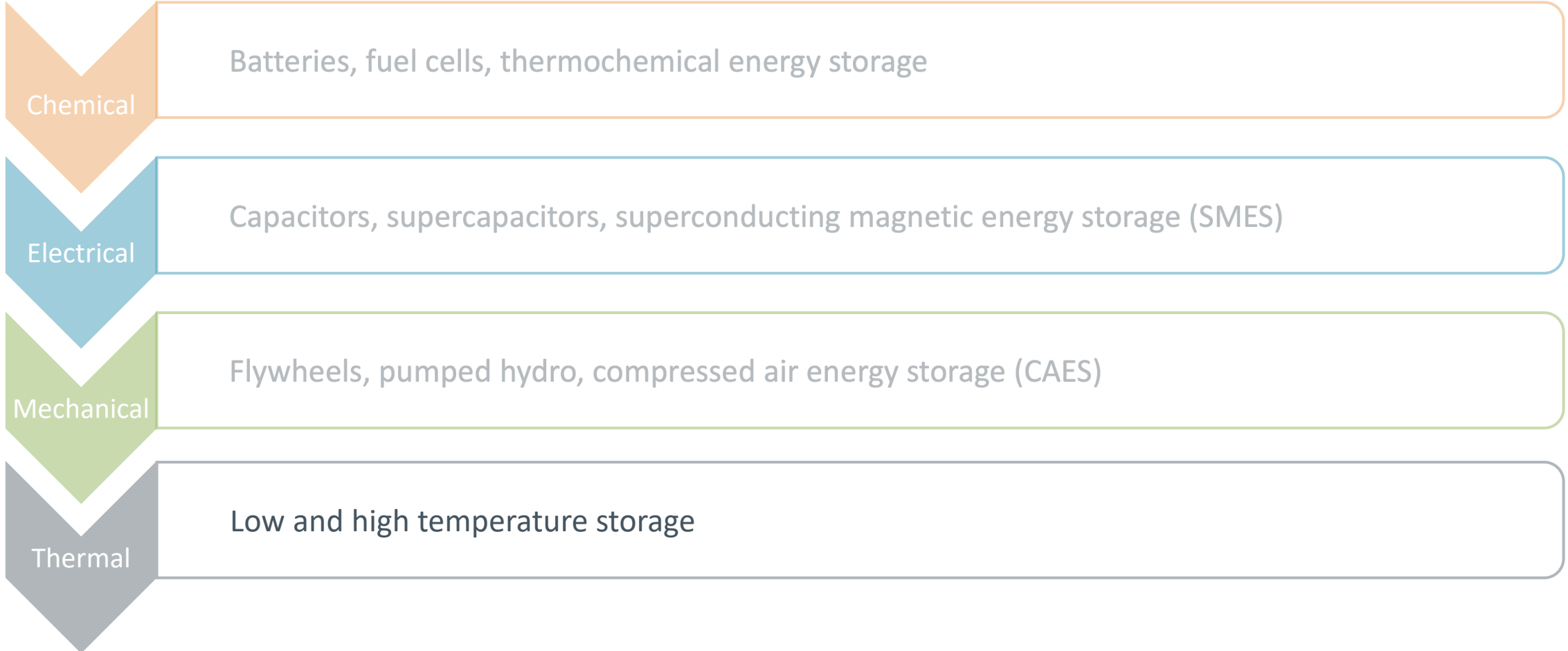
Thermal Energy Storage

Low and High Temperature Energy Storage

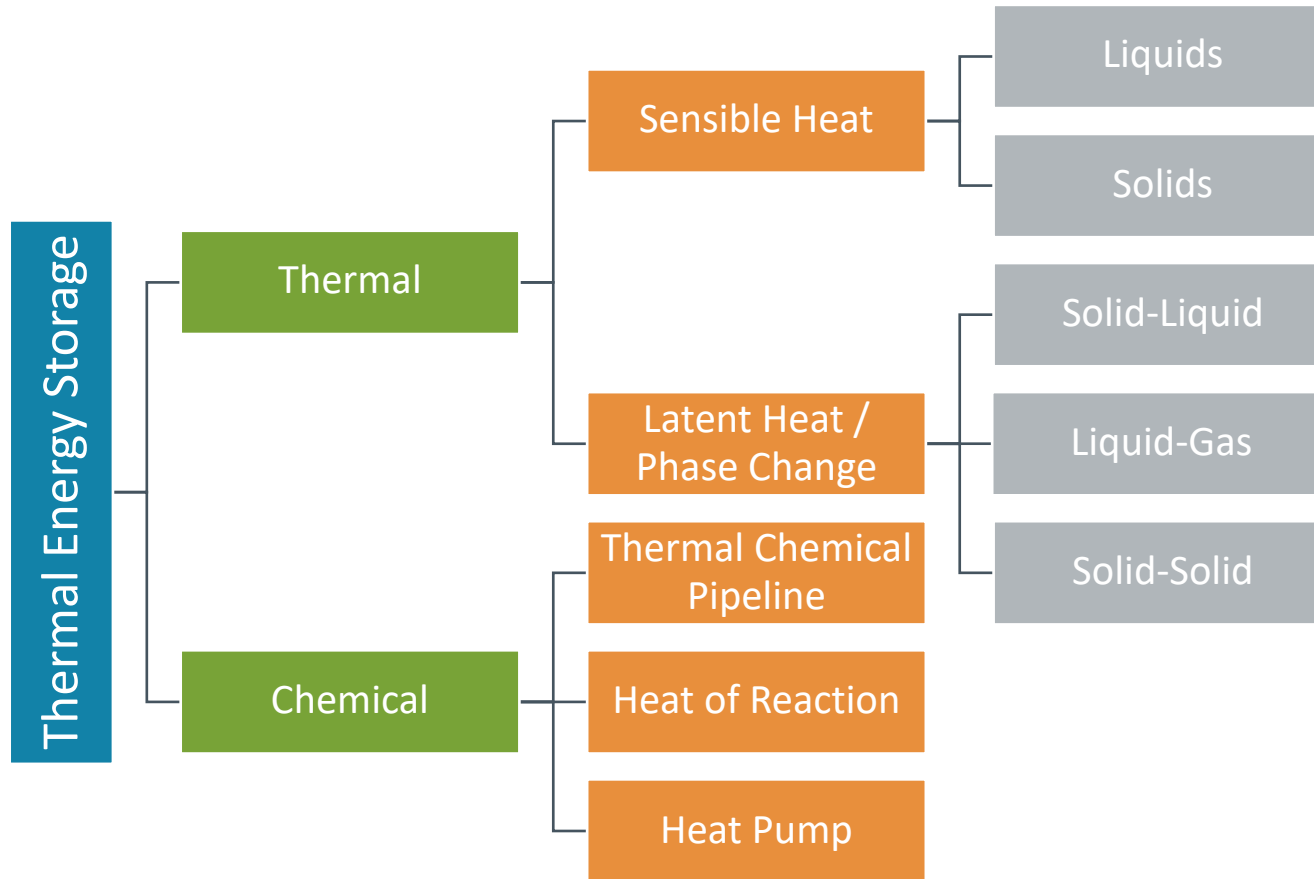
Recommended for grades 7-12

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Thermal Energy Storage



Multiple types of Thermal Energy Storage (TES)



- TES stores thermal energy by heating and cooling the storage medium
- Storage mediums can be liquid, solid, gas or a combination of phases
- Stored energy can be used for heating, cooling, and power generation

Thermal Energy System Performance Data

Key Performance Data

System	Capacity (kWh/t)	Power	Efficiency (%)	Duration
Sensible Heat Storage	10-50	1 kW – 10.0 MW	50 – 90	Days – months
Phase Change Storage	50-150	1 kW – 1.0 MW	75 – 90	Hours – months
Thermochemical Energy Storage	120-250	10 kW – 1.0 MW	75 – 100	Hours – days

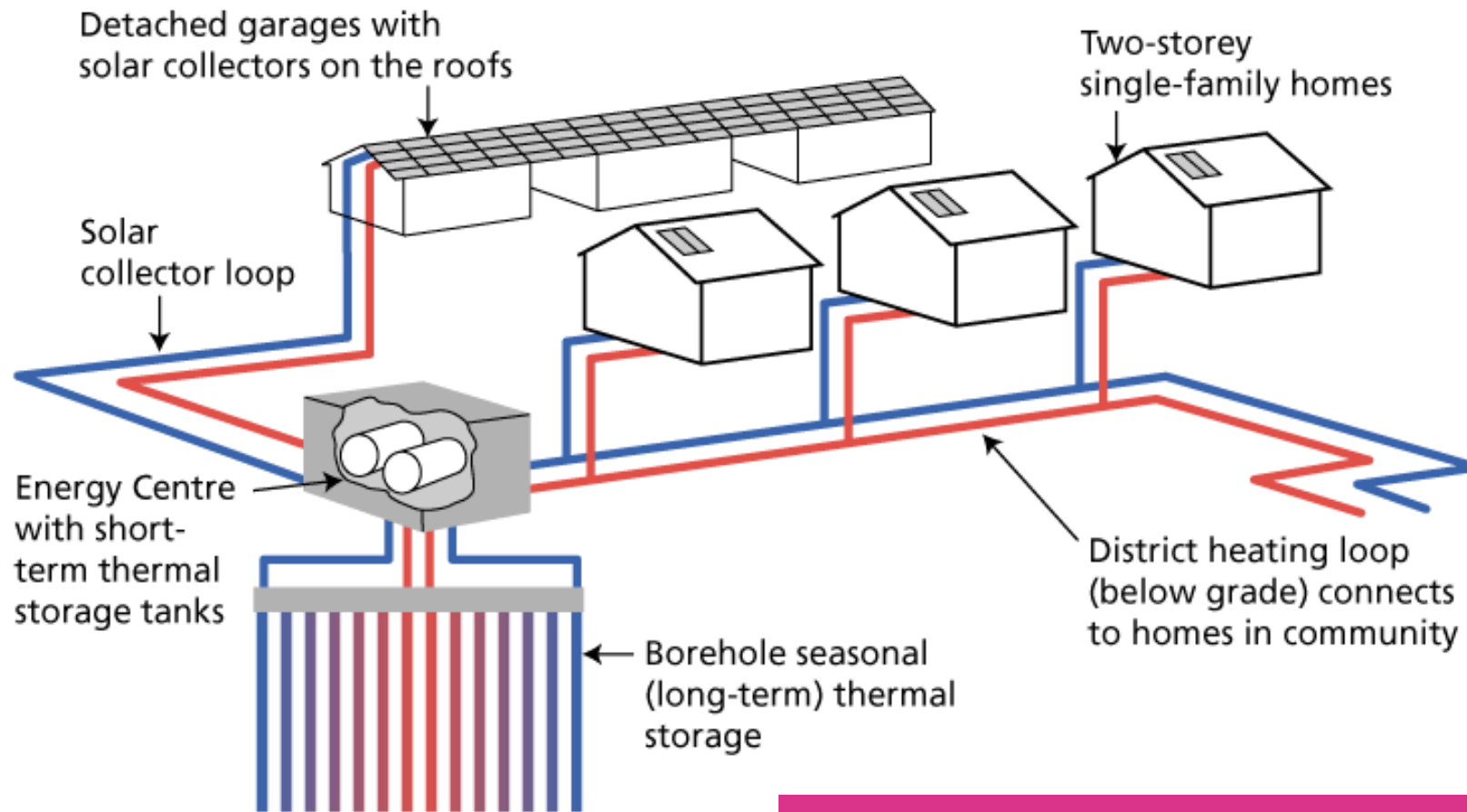
Thermal energy storage is typically used on residential or commercial buildings

Sensible Heat Storage

- Sensible heat storage uses the heat change of a material without changing its phase to store energy
- The temperature of the storage material (solid or liquid) rises when energy is stored (charging) and cools when the energy is released (discharged)
- The charge and discharge process is reversible, and can undergo an unlimited number of cycles
- Water is commonly used. Other storage media include sand, molten salts, and rocks
 - Water has a high specific heat capacity and is therefore ideal for storage
- Sensible heat storage is **low cost** and does not emit toxic chemicals

Specific heat capacity: the amount of heat required to raise the substance's temperature by 1 unit (K) per unit mass (g)

Thermal Energy Storage in Alberta – Drakes Landing Solar Community, Okotoks, Alberta



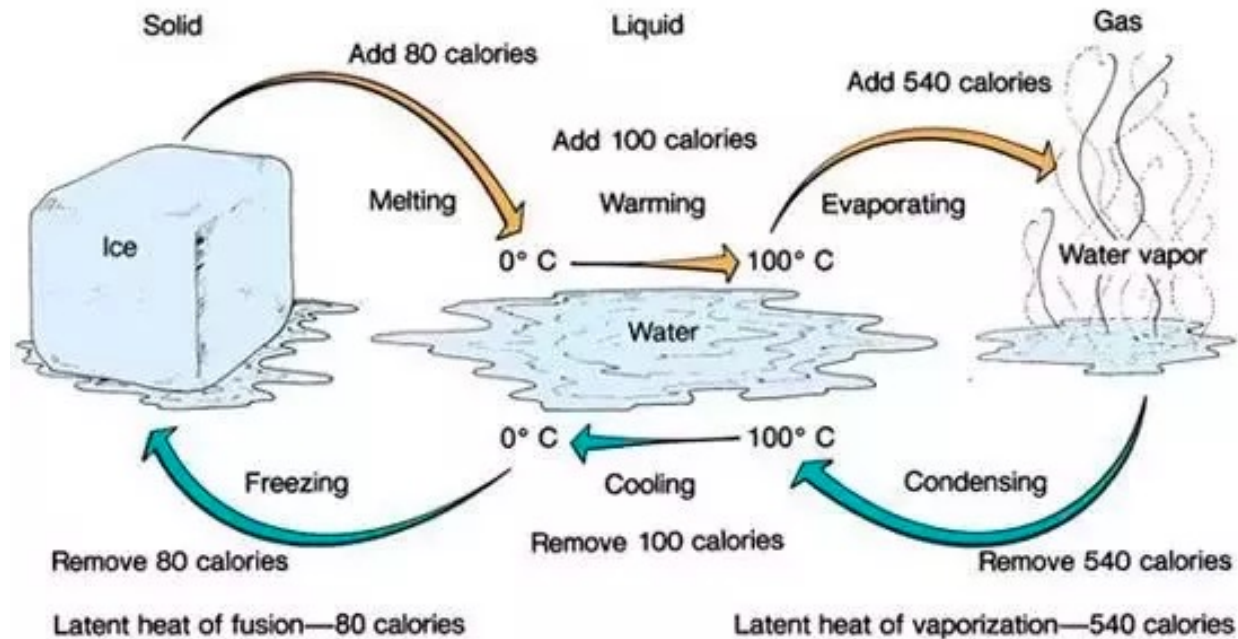
- Solar energy is collected from 62 homes
- Water is used as the storage medium
- Uses sensible heat and underground storage of the heat
- During the summer, the long-term borehole storage is used
- In the winter, the short-term thermal storage is required

Example of Sensible Heat Storage

Drakes Landing Solar Community – Video (9 min 44 sec)



Latent Heat / Phase Change Storage

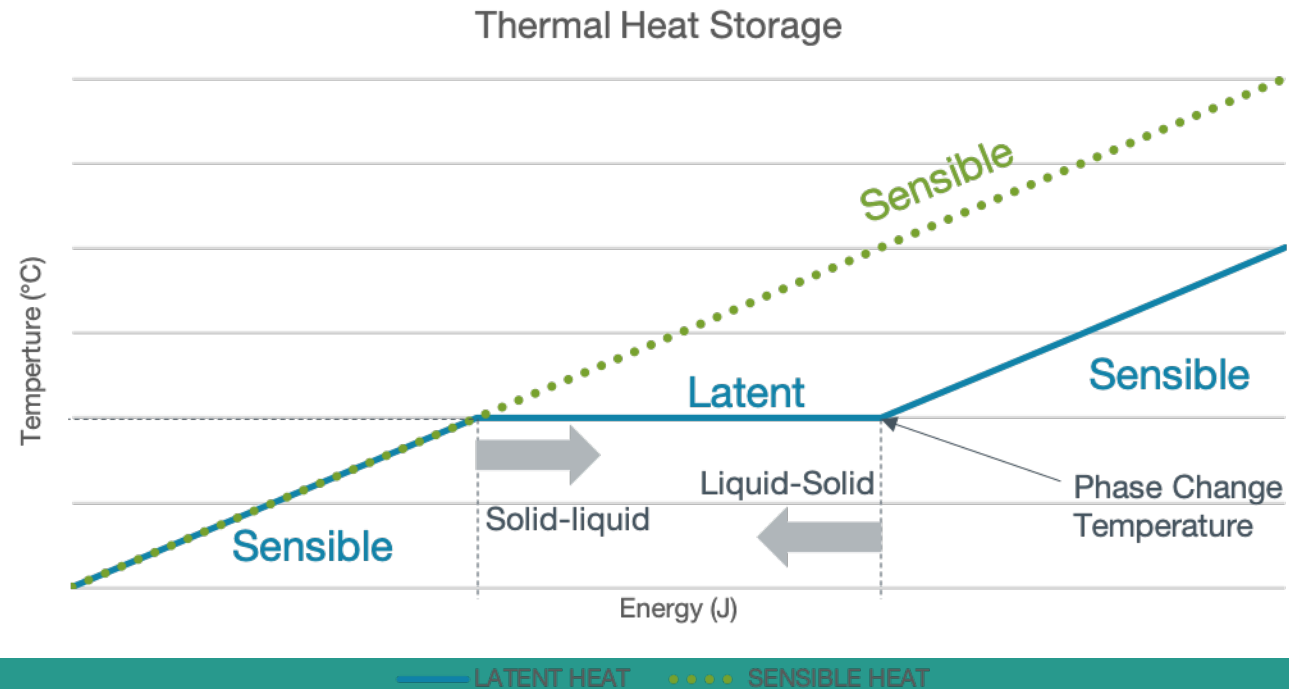


- Latent heat storage, also known as phase change storage stores thermal energy through a phase change such as liquid to gas, solid to liquid, liquid to liquid
- The temperature remains **constant** during the process

Latent heat: the heat required for a substance to undergo a phase change without a change in temperature

Latent Heat Storage

- Latent heat is more advantageous over sensible heat because temperature stay constant
- Latent heat behaves like sensible heat to start, until temperature is constant
 - The temperature released is equal to the temperature absorbed



Thermochemical Energy Storage

- Chemical reaction storage uses thermochemical materials to store and release energy in the form of heat
- Endothermic and exothermic chemical reactions are used
- All reactions are **reversible** so the energy can be retrieved

Example: **CHARGING**



An endothermic process
absorbs heat

Heat is stored in the
products B and C

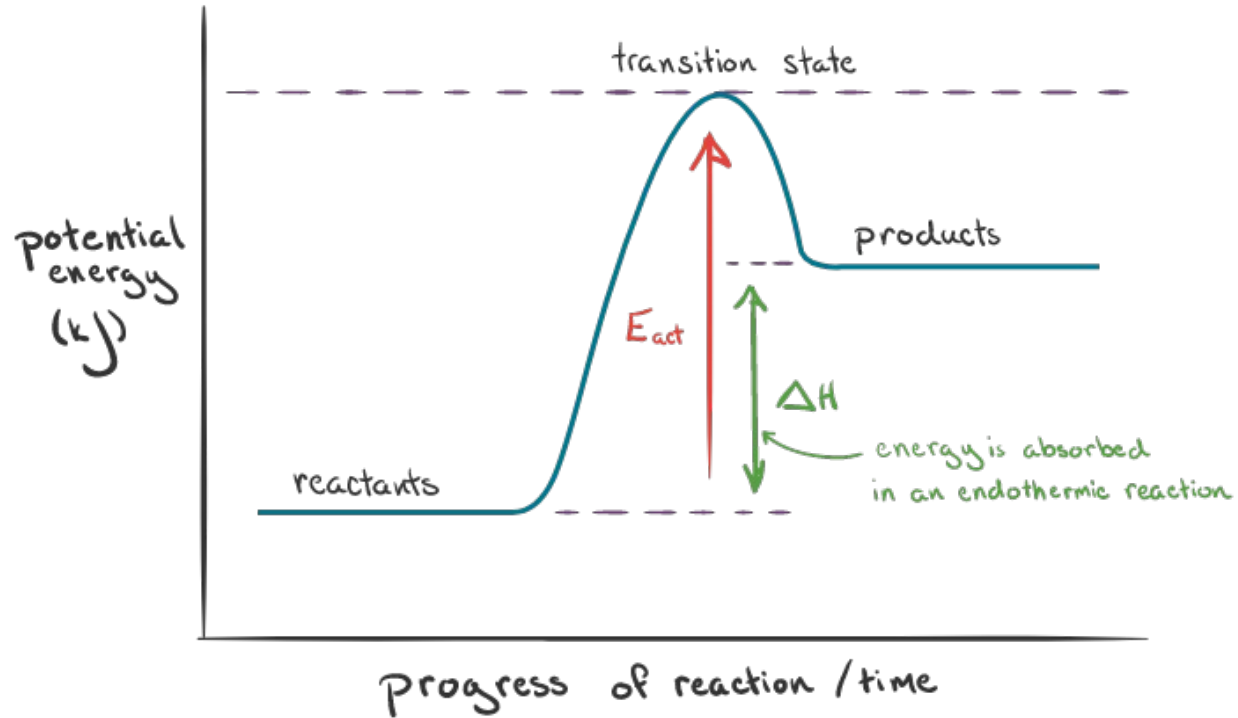
Example: **DISCHARGING**



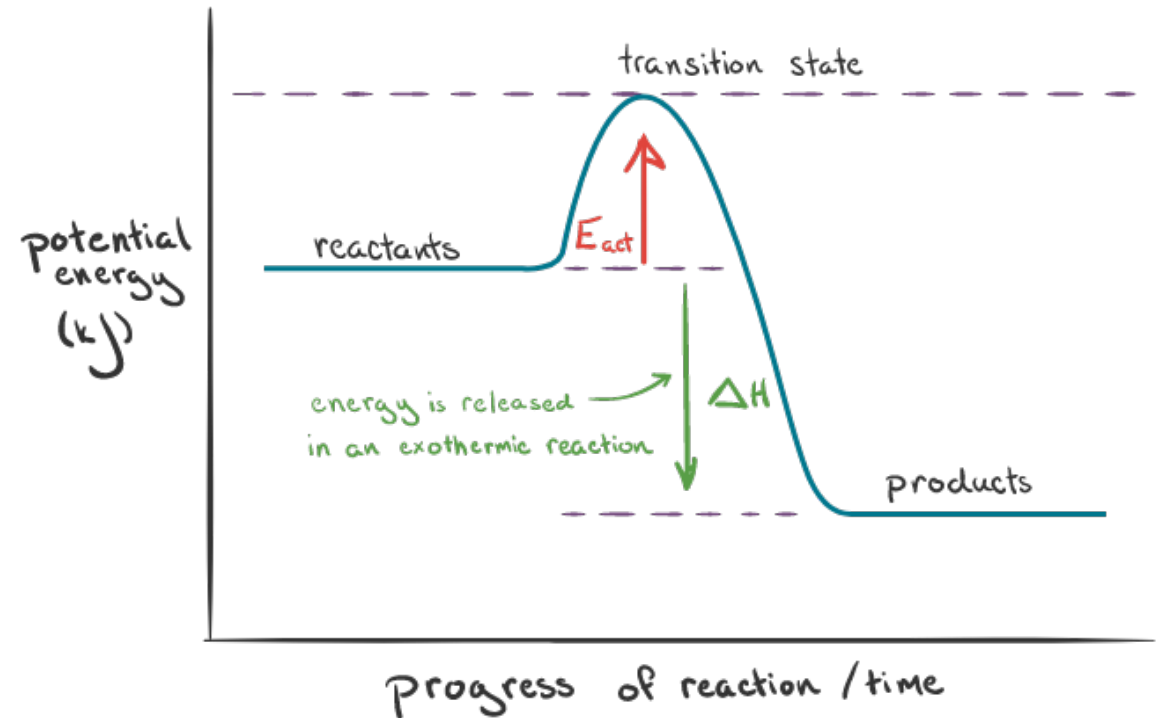
An exothermic process
releases heat

Heat is released when B
and C react together

Endothermic and Exothermic Reactions



Endothermic Reaction
Charging



Exothermic Reaction
Discharging

Endothermic and Exothermic Reactions Activity

- This activity will test if you can differentiate between an exothermic and an endothermic reaction
- See the activity hand out for instructions

Did You Know: You can tell something is exothermic if it is hot to the touch and endothermic if it is cold to the touch



Exothermic



Endothermic



Thank you!

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