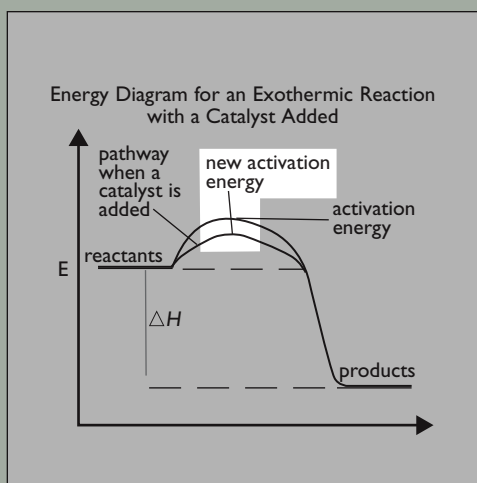


The scientists and engineers who designed the MRE heater made two modifications to make the reaction produce heat faster. First, the MRE heater uses smaller, ground-up particles of magnesium. The smaller particles give the magnesium a greater surface area. This allows more water molecules to come in contact with the magnesium atoms, which speeds up the reaction. Second, the MRE heater also uses a **catalyst**. A catalyst is a substance that speeds up a chemical reaction without being used up itself. A catalyst works by providing a lower-energy alternative pathway for the reaction to take. In essence, it provides a lower activation energy (a lower energy barrier). As a result, more starting materials at a given temperature have enough energy to get over the energy barrier. This speeds up the reaction.

Remember that when you compared different magnesium samples, the sample containing NaCl reacted much more quickly than the others. However, if you look at the chemical equation that represents the reaction, NaCl is not a reactant. It provides a chloride ion, Cl^- , that acts as a catalyst. This speeds up the rate of the reaction between magnesium and water remarkably, so it produces heat faster.



Checking Up

1. What does it mean for a change to occur spontaneously?
2. What two questions must be answered to determine if a change can occur spontaneously?
3. What evidence do you look for to tell if a change is exothermic or endothermic?
4. From where does the energy in an exothermic reaction come?
5. What are two things that chemists or engineers designed into the MRE heater to make the reaction happen faster?
6. What does a catalyst do to speed up a reaction?
7. How does an energy profile graph look for a reaction with a catalyst vs. one without a catalyst? What's different? What's the same?

What Do You Think Now?

At the beginning of this activity you were asked:

- What is the source of the heat produced by the hot pack?
- How is the hot pack able to increase in temperature without an external (added) source of heat?

Now that you have explored the MRE heater, how would you answer these questions?