collisions
HIGHER EDUCATION

CONTENT AREA OVERVIEW

LeChâtelier

playmada™

SNAPSHOT

Challenges

- The Challenge Levels increase in rigor and complexity.
- The first 4 levels are tutorial levels.
  - 21 core levels

Sandbox

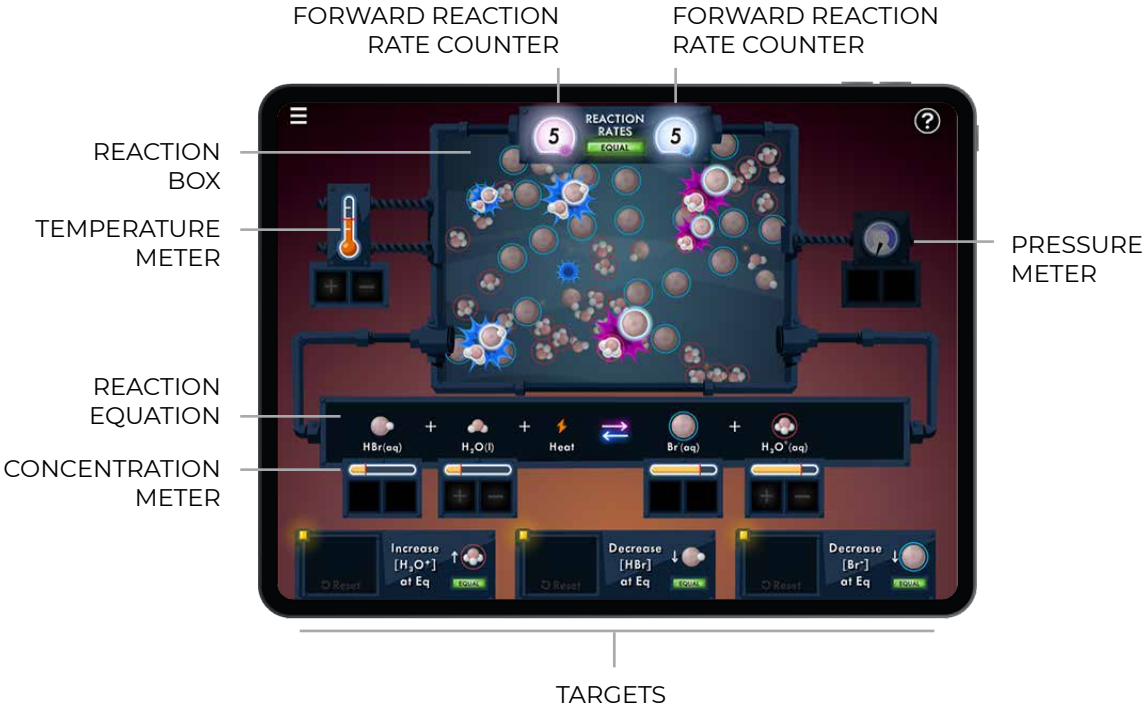
- The Sandbox is an exploratory learning space for extended practice and review of the LeChâtelier Game.
- 14 Achievements

Integrated Chemistry Concepts

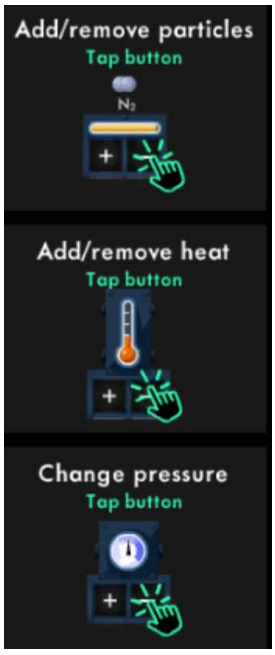
- Relative reaction rates (forward vs reverse)
- Relative K_c
- LeChatelier's Principle (concentration disturbances)
- LeChatelier's Principle (temperature disturbances)
- LeChatelier's Principle (pressure disturbances)

GAMEPLAY BASICS

LeChâtelier Game Level Layout



Skills

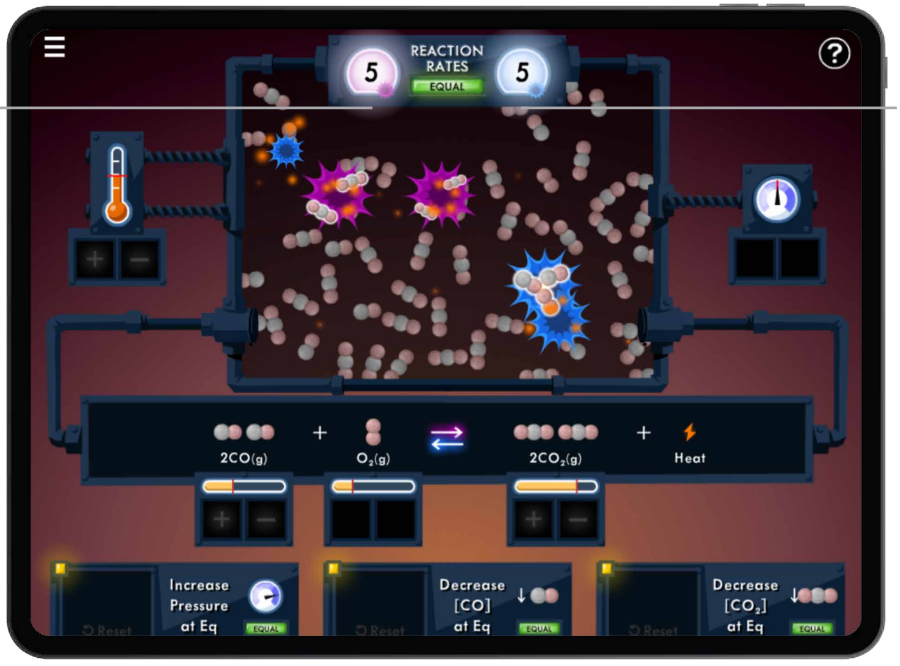


OVERVIEW

LeChâtelier Sandbox

Achievements

OVERVIEW

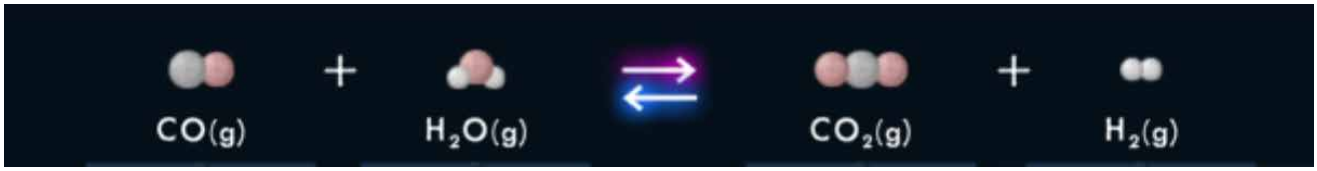


LeChâtelier Challenges

LEVELS 1-21 GOAL:
Disturb the reaction to cause changes to the system at equilibrium.

CHEMISTRY CONNECTIONS

CHEMISTRY CONCEPT:
All reactions can proceed in the forward and reverse directions.



FORWARD REACTION:
$CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$

REVERSE REACTION:
$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$

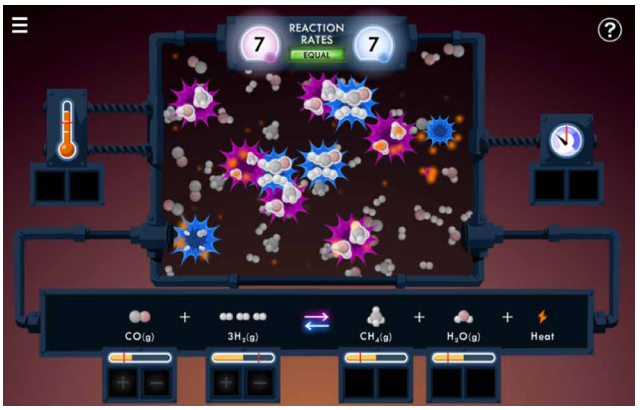
CHEMISTRY CONCEPT:
At equilibrium, the rate of the forward and reverse reactions are equal.

AT EQUILIBRIUM, BOTH THE FORWARD AND REVERSE REACTIONS ARE HAPPENING.

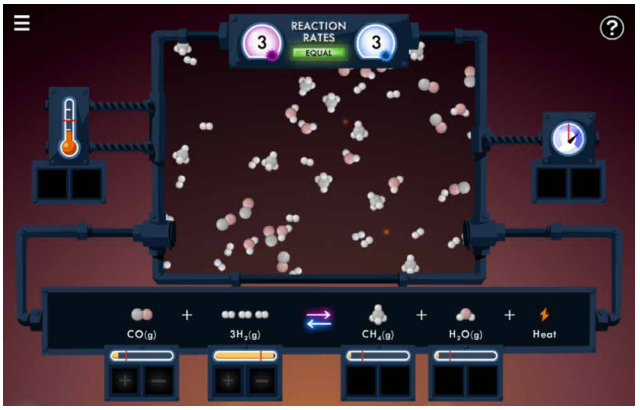
CHEMISTRY CONNECTIONS

CHEMISTRY CONCEPT: When a system at equilibrium is disturbed by change in concentration, it will adjust to reestablish equilibrium.

CHANGE IN REACTANTS



INCREASE REACTANTS → RETURN TO EQUILIBRIUM (SHIFTS RIGHT) → INCREASE PRODUCTS

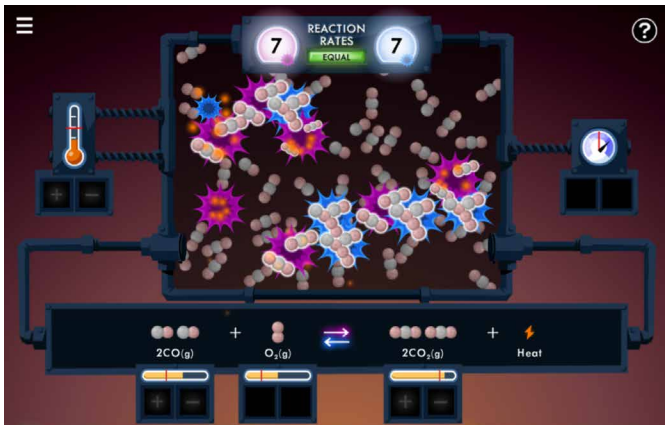


DECREASE REACTANTS → RETURN TO EQUILIBRIUM (SHIFTS LEFT) → DECREASE PRODUCTS

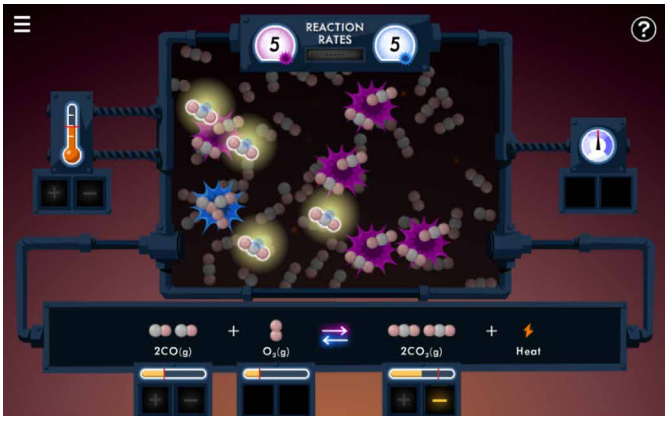
CHEMISTRY CONNECTIONS

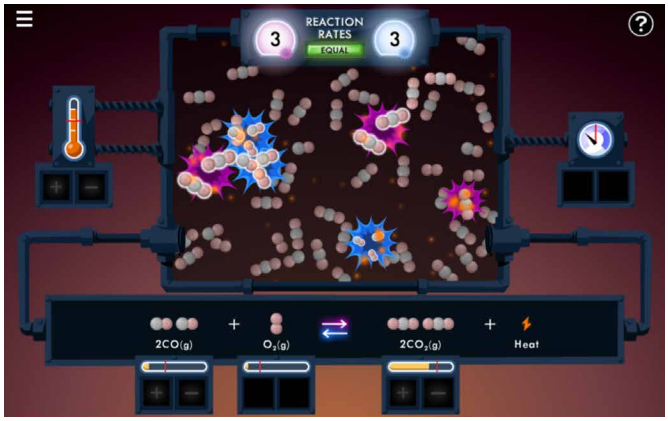
CHEMISTRY CONCEPT: When a system at equilibrium is disturbed by change in concentration, it will adjust to reestablish equilibrium (cont.).

CHANGE IN PRODUCTS



INCREASE PRODUCTS → RETURN TO EQUILIBRIUM (SHIFTS LEFT) → INCREASE REACTANTS





DECREASE PRODUCTS → RETURN TO EQUILIBRIUM (SHIFTS RIGHT) → DECREASE REACTANTS

CHEMISTRY CONNECTIONS

EXOTHERMIC REACTIONS

CHEMISTRY CONCEPT:
When a system at equilibrium is disturbed by change in temperature, it will adjust to reestablish equilibrium.

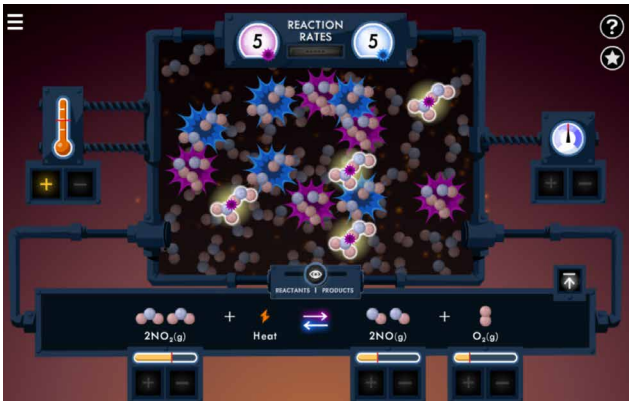
INCREASE TEMPERATURE → RETURN TO EQUILIBRIUM (SHIFTS LEFT) → DECREASE PRODUCTS

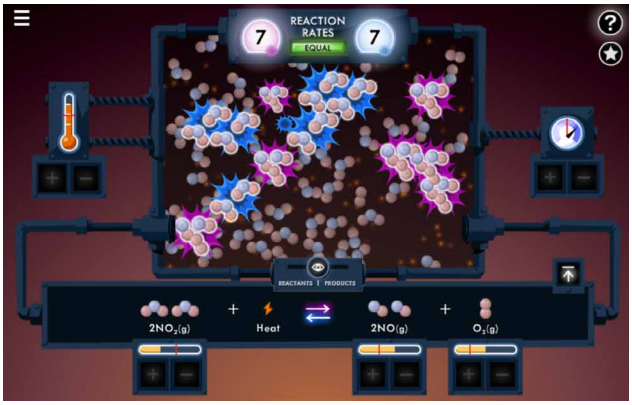
DECREASE TEMPERATURE → RETURN TO EQUILIBRIUM (SHIFTS RIGHT) → INCREASE PRODUCTS

CHEMISTRY CONNECTIONS

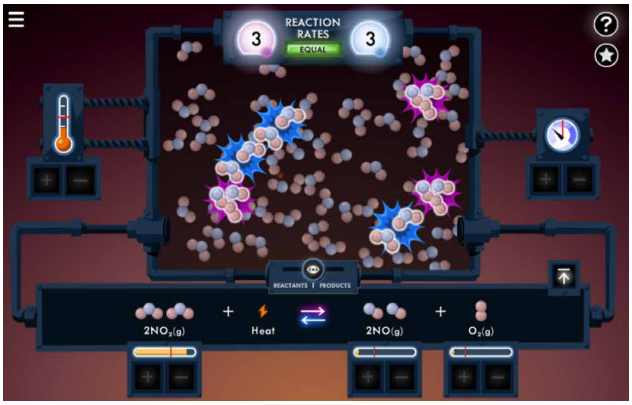
CHEMISTRY CONCEPT: When a system at equilibrium is disturbed by change in temperature, it will adjust to reestablish equilibrium (cont.).

ENDOTHERMIC REACTIONS





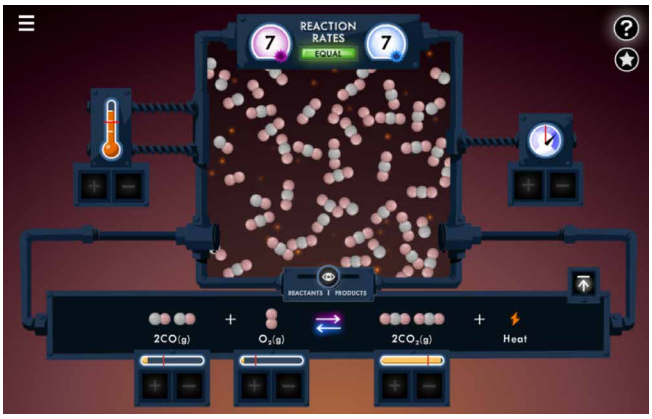
INCREASE TEMPERATURE → RETURN TO EQUILIBRIUM (SHIFTS RIGHT) → INCREASE PRODUCTS



DECREASE TEMPERATURE → RETURN TO EQUILIBRIUM (SHIFTS LEFT) → DECREASE PRODUCTS

CHEMISTRY CONNECTIONS

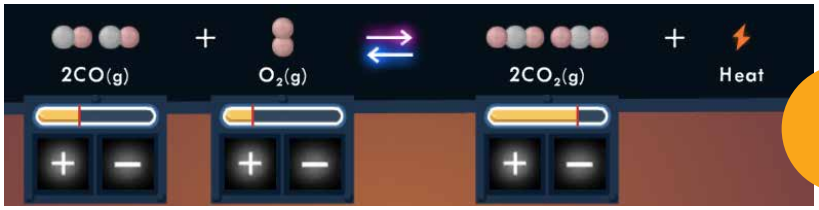
CHEMISTRY CONCEPT: When a system at equilibrium is disturbed by change in pressure, it will adjust to reestablish equilibrium.



INCREASE PRESSURE → INCREASE CHANCE OF COLLISIONS ON THE SIDE WITH MORE MOLECULES
→ REACTION SHIFTS TO DIRECTION WITH **FEWER MOLECULES**

DECREASE PRESSURE → DECREASE CHANCE OF COLLISIONS ON THE SIDE WITH MORE MOLECULES
→ REACTION SHIFTS TO DIRECTION WITH **MORE MOLECULES**

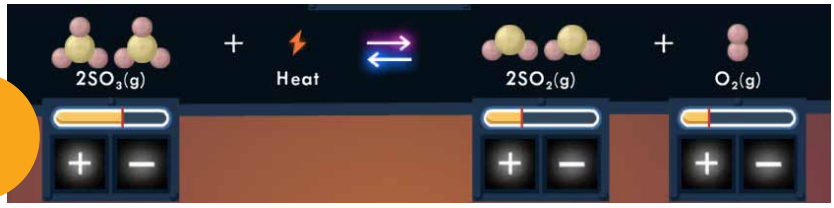
CHEMISTRY CONNECTIONS



PRODUCTS EXCEED REACTANTS → $K_c > 1$

CHEMISTRY CONCEPT: When the equilibrium constant (K_c) for a reaction is **greater than 1**, the products are favored at equilibrium.

CHEMISTRY CONCEPT: When the equilibrium constant (K_c) for a reaction is **less than 1**, the reactants are favored at equilibrium.



REACTANTS EXCEED PRODUCTS → $K_c < 1$

REACTANT CONCENTRATION SIMILAR TO PRODUCTS → $K_c \approx 1$

CHEMISTRY CONCEPT: When the equilibrium constant (K_c) for a reaction is **near 1,** the reactants and products exist in similar concentrations at equilibrium.