

A graphic showing two overlapping circles with a starburst effect, representing a collision.

collisions®

Phase Change Game Guide

Phase Change Snapshot

Challenges

The Challenge Levels increase in rigor and complexity.

The first 7 levels are tutorial levels.

- 15 core levels
- 3 connected levels to Ionic Bonding
- 3 connected levels to Intermolecular Forces

Sandbox*

The Sandbox is an exploratory learning space for extended practice and review of phase change.

- 14 Achievements

* Players must complete Challenge Levels 1-7 before unlocking the Sandbox.

Integrated Chemistry Concepts

- 6 phase changes (melting, boiling, sublimation, freezing, condensation, deposition)
- Breaking/forming IMF's
- Constant temperature during a phase change
- IMF strength & boiling point

General Information

Phases

Solid



Liquid



Gas

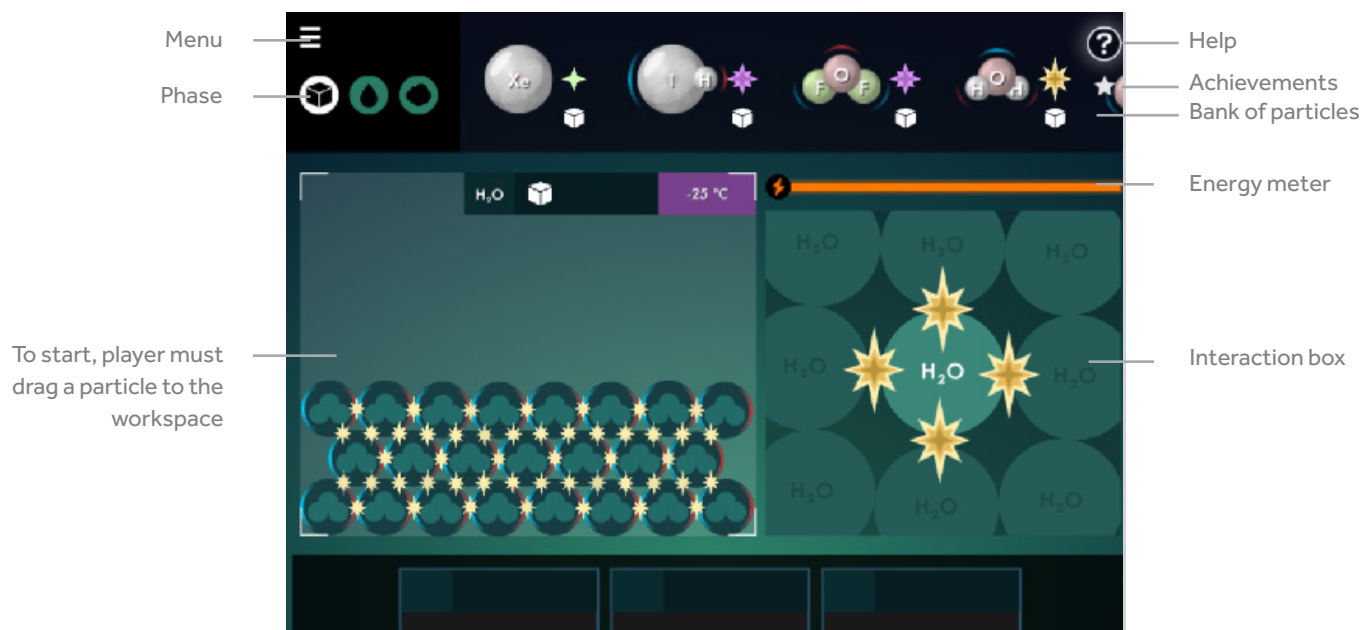


Skills

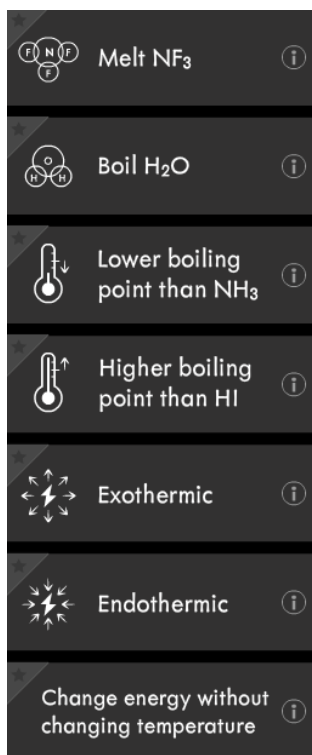
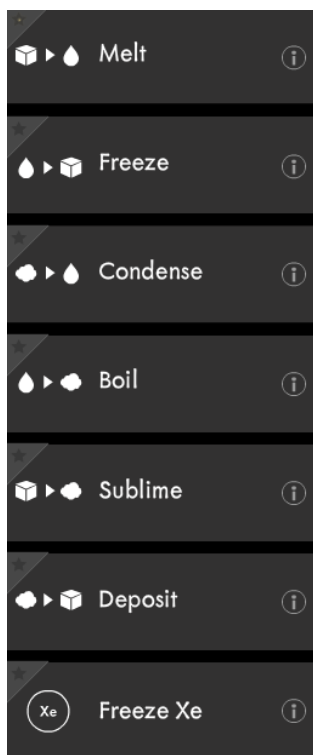


Phase Change: Overview

Phase Change Sandbox



Achievements



Selected Bank of Particles

Ne	N ₂
Ar	NF ₃
Xe	NH ₃
HI	HCN
OF ₂	CH ₂ O
H ₂ O	CH ₄
SO ₂	CH ₃ F
CO ₂	NaCl
	MgO

Phase Change: Overview (cont.)

Phase Change Challenges

LEVEL GOAL : Cause phase changes in target sequences by adding or removing energy to affect particle motion and to break and form intermolecular forces.

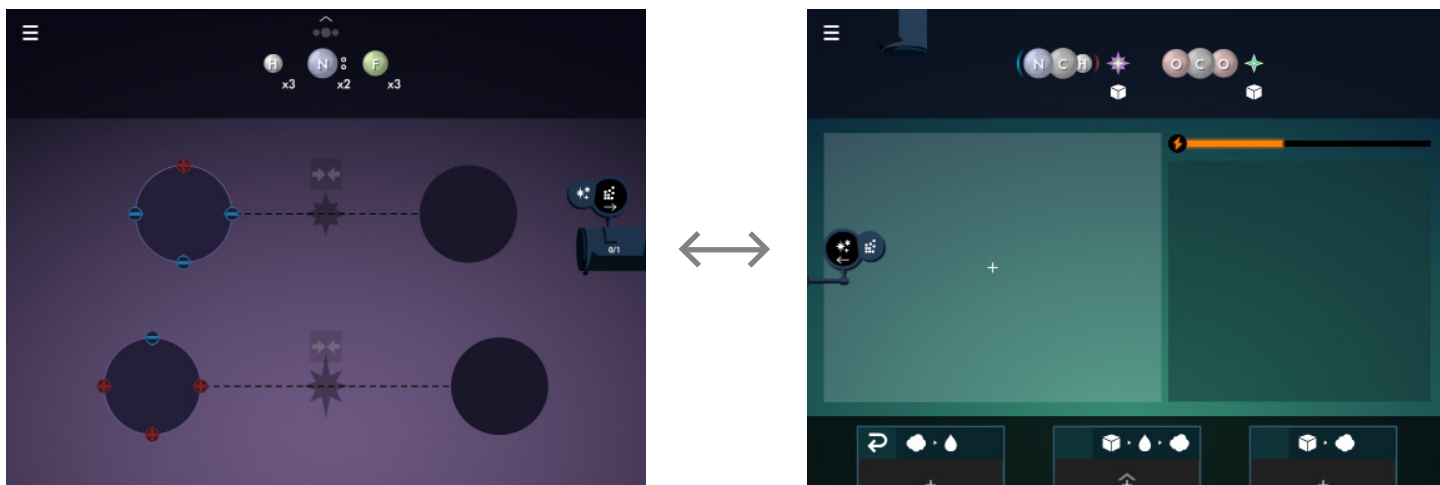


Restricted bank of particles

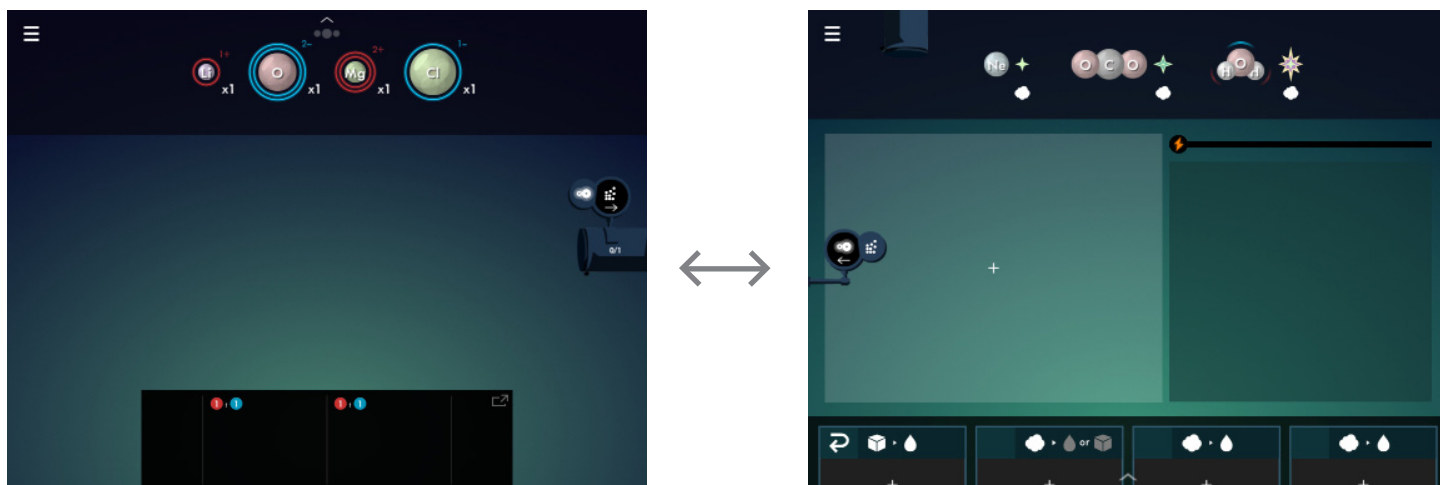
Level targets

Phase Change: Overview (cont.)

IMFs to PHASE CHANGE CONNECTED LEVELS GOAL: There are particles missing from the bank. Use the button on the left to go to IMFs. Solve the Challenge and bring back the missing particles!



IONIC BONDING to PHASE CHANGE CONNECTED LEVELS GOAL: There are ionic compounds missing from the bank. Use the button on the left to go to IONIC BONDING. Solve the Challenge and bring back the missing ionic compounds!

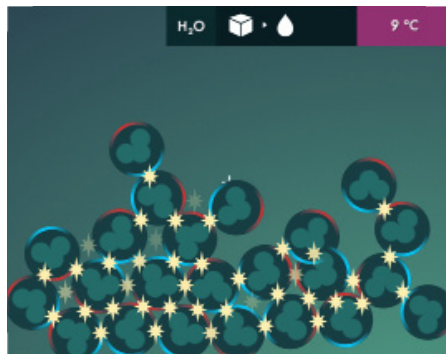


Phase Change: Chemistry Connections

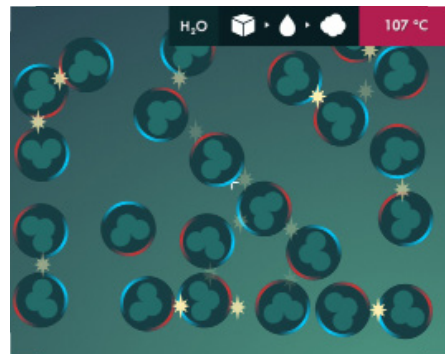
CHEMISTRY CONCEPT: The motion of particles increases from solid to liquid to gas.



SOLID



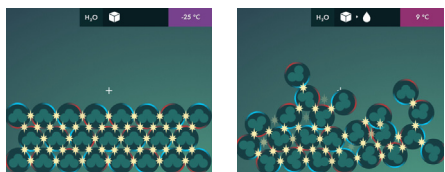
LIQUID



GAS

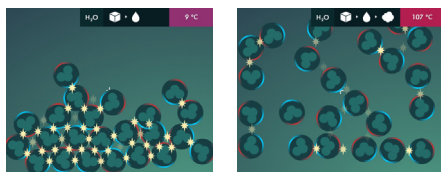
CHEMISTRY CONCEPT: There are 6 types of phase change.

Melting



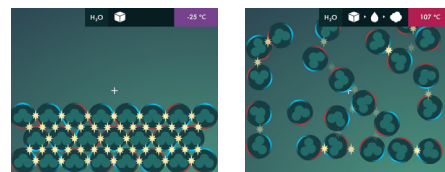
Solid → Liquid

Boiling



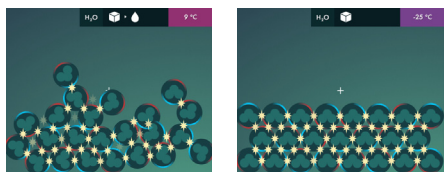
Liquid → Gas

Sublimation



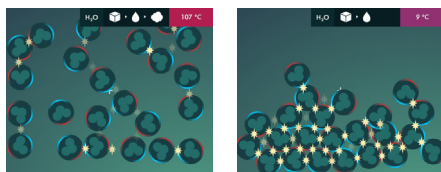
Solid → Gas

Freezing



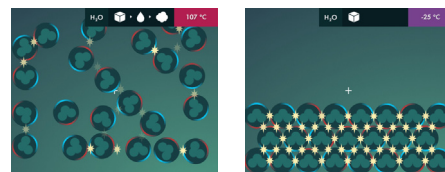
Liquid → Solid

Condensation



Gas → Liquid

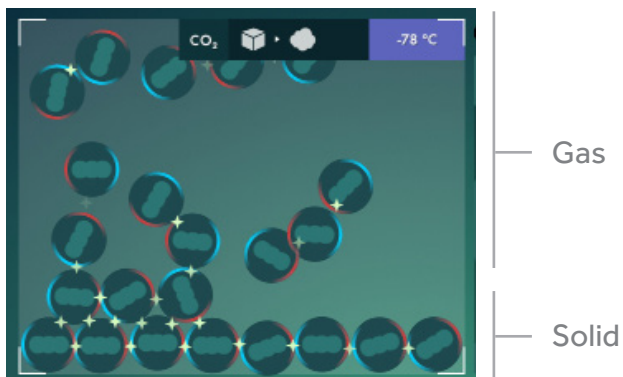
Deposition



Gas → Solid

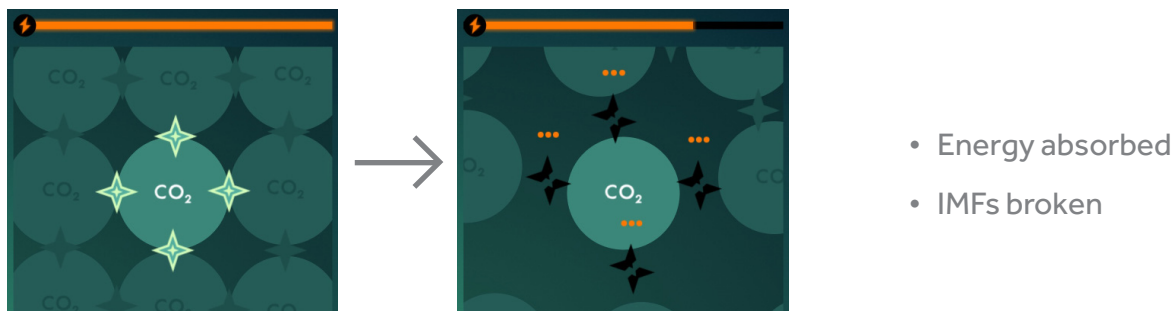
Phase Change: Chemistry Connections (cont.)

CHEMISTRY CONCEPT: During a phase change, there are two phases present.

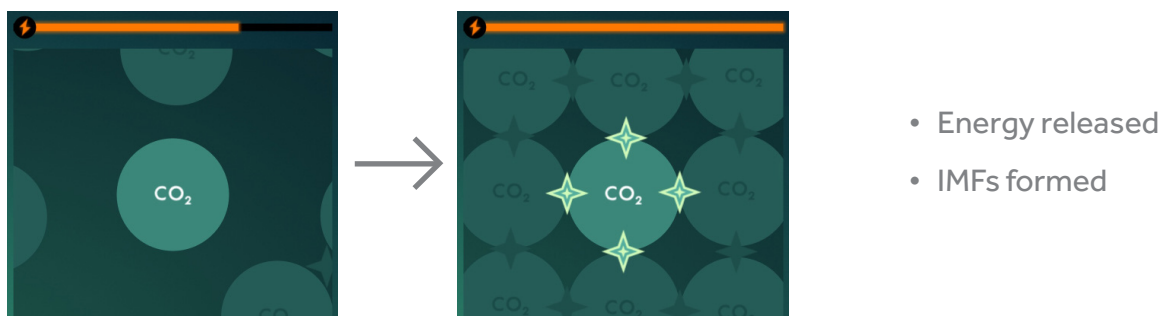


CHEMISTRY CONCEPT: During phase changes, energy can be absorbed (endothermic) to break IMFs or energy can be released (exothermic) by the formation of IMFs.

Energy (heat) is absorbed during melting, boiling and sublimation and IMFs are broken.

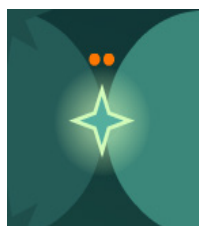


Energy (heat) is released during freezing, condensation and deposition and IMFs are formed.

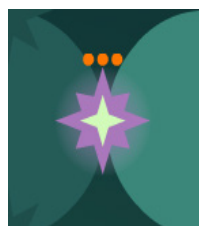


Phase Change: Chemistry Connections (cont.)

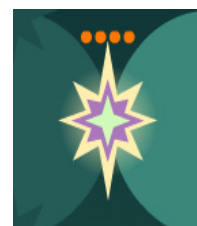
CHEMISTRY CONCEPT: A substance with stronger intermolecular forces will require more energy (heat) to melt, boil, or sublime.



LDF



Dipole-Dipole



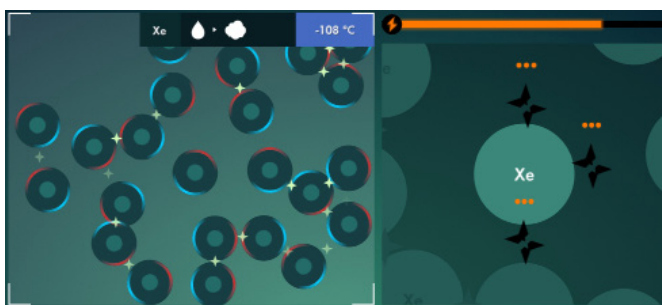
Hydrogen Bond

Less Energy Required  More Energy Required

CHEMISTRY CONCEPT: The stronger the intermolecular forces between a substance, the higher the boiling point.

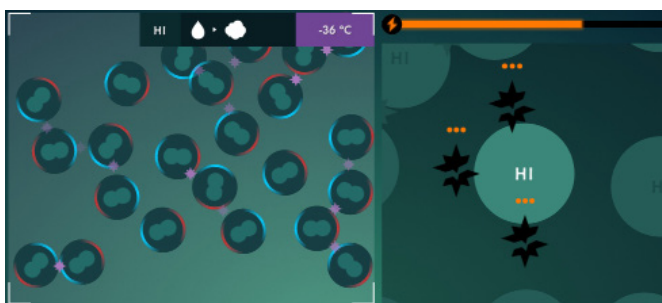
London Dispersion Forces

- Xe
- Boiling Point : -108°C



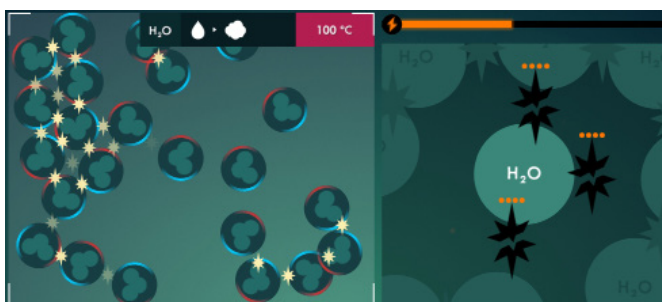
Dipole-Dipole

- HI
- Boiling Point : -36°C



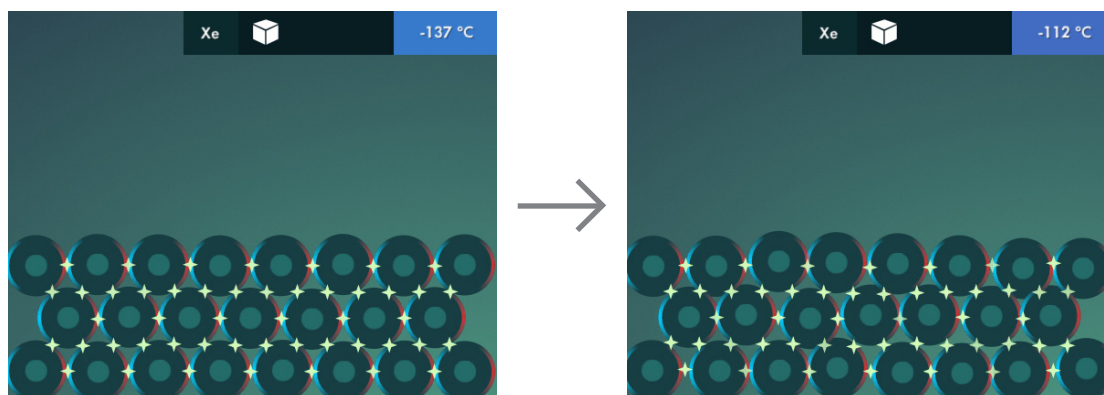
Hydrogen Bonding

- H_2O
- Boiling Point : 100°C



Phase Change: Chemistry Connections (cont.)

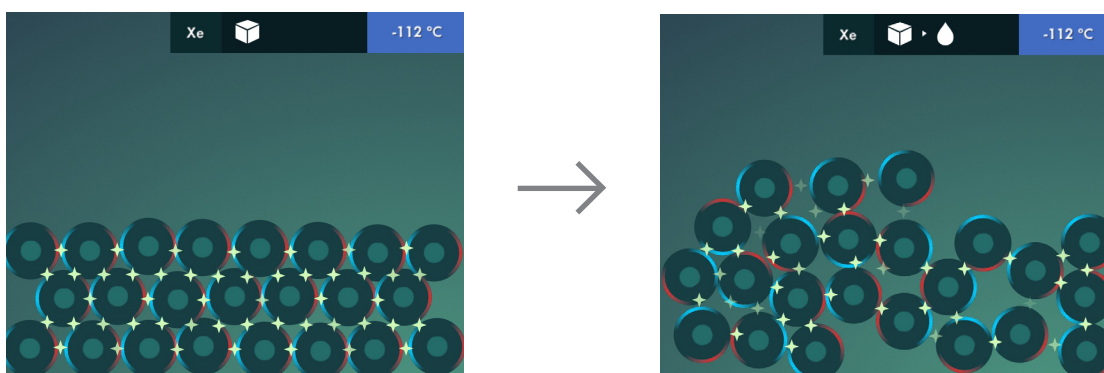
CHEMISTRY CONCEPT: When energy (heat) is added, the temperature of the substance will increase if there is no phase change occurring.



Heat is added:

- Temperature increases (kinetic energy of particles increases)
- Phase does not change

CHEMISTRY CONCEPT: When energy (heat) is added during a phase change (melt, boil, sublime), the energy is used to break IMFs and does not change the temperature of the substance.



Heat is added:

- Temperature does not change
- Phase change occurs