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Ions Game Guide

Ions Snapshot

Challenges

The Challenge Levels increase in rigor and complexity.

The first level is a tutorial.

- 15 core levels
- 3 connected levels to Atoms

Sandbox*

The Sandbox is an exploratory learning space for extended practice and review of ions.
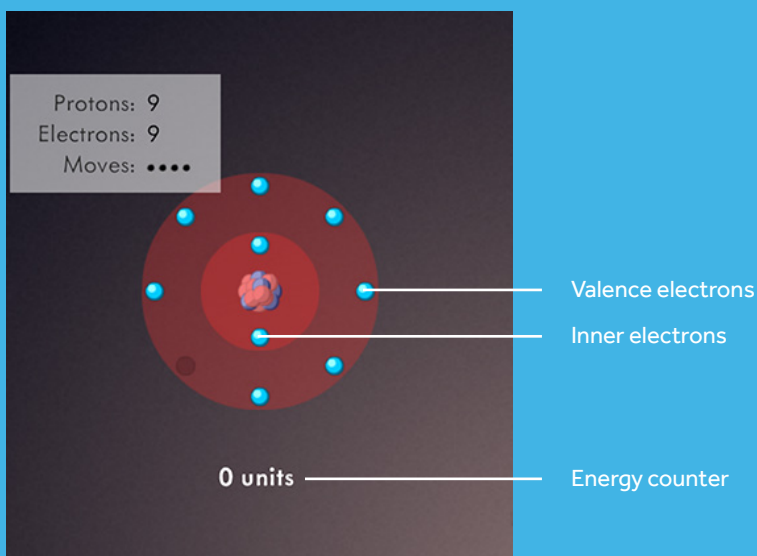
- 11 Achievements

* Players must complete Levels 1-8 before unlocking the Sandbox.
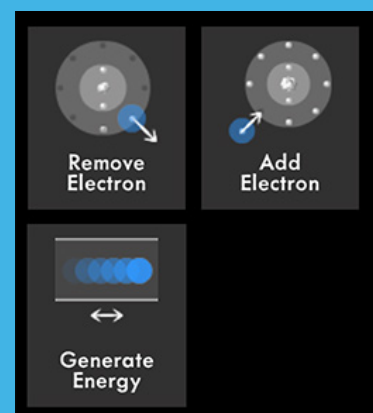
Integrated Chemistry Concepts

- Cation and anion formation
- Octet rule
- Ionic radii
- Ionization energy
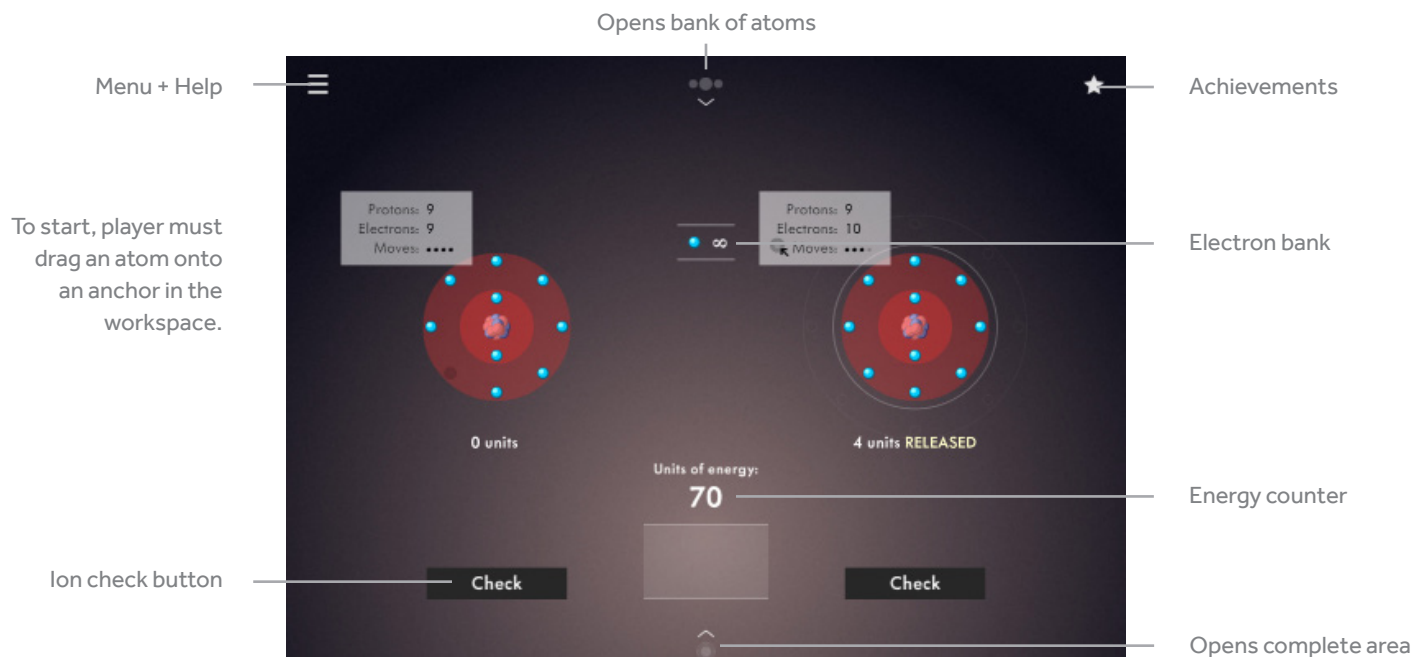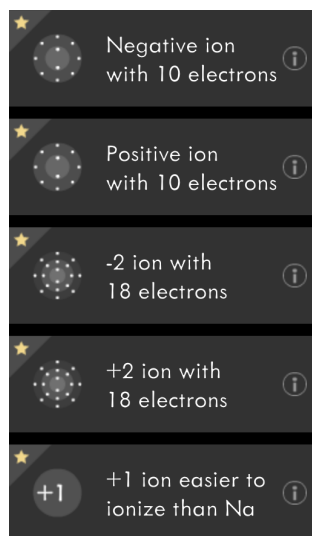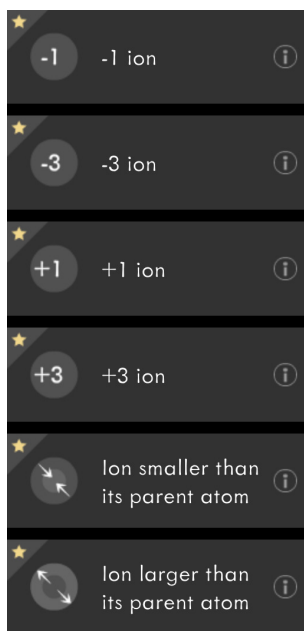

General Information

'Atom Ionization' mode

Protons: 9
Electrons: 9
Moves: ••••

Valence electrons

Inner electrons

0 units — Energy counter

Skills

Remove Electron

Add Electron

Generate Energy

Ions: Overview

Ions Sandbox

Opens bank of atoms

Menu + Help

Achievements

To start, player must drag an atom onto an anchor in the workspace.

Electron bank

Protons: 9
Electrons: 9
Moves: ● ● ● ●

Protons: 9
Electrons: 10
Moves: ● ● ●

0 units

4 units RELEASED

Units of energy:
70

Energy counter

Ion check button

Check

Check

Opens complete area

Achievements

-1	-1 ion (i)
-3	-3 ion (i)
+1	+1 ion (i)
+3	+3 ion (i)
	Ion smaller than its parent atom (i)
	Ion larger than its parent atom (i)

	Negative ion with 10 electrons (i)
	Positive ion with 10 electrons (i)
	-2 ion with 18 electrons (i)
	+2 ion with 18 electrons (i)
+1	+1 ion easier to ionize than Na (i)

Selected Bank of Atoms

The bank includes the following atoms:

|	
Lithium	Phosphorous
Beryllium	Sulfur
Boron	Chlorine
Nitrogen	Potassium
Oxygen	Calcium
Fluorine	Arsenic
Sodium	Selenium
Magnesium	Bromine
Aluminum	

Ions: Overview (cont.)

Ions Challenges

LEVELS 1 - 15 GOAL: Add or remove electrons from atoms to make ions that match the targets.

Restricted bank of atoms

Electron bank

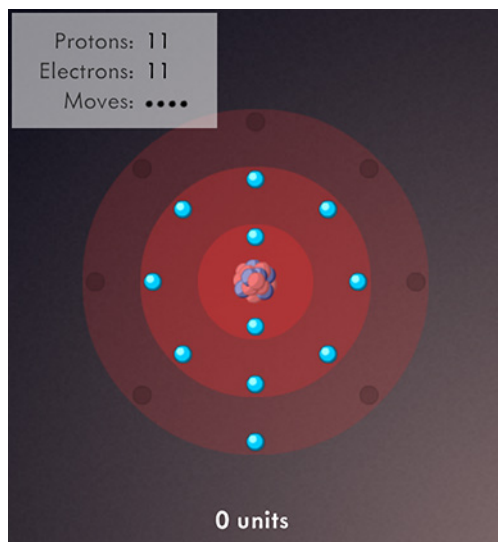Fixed amount of energy

Level targets
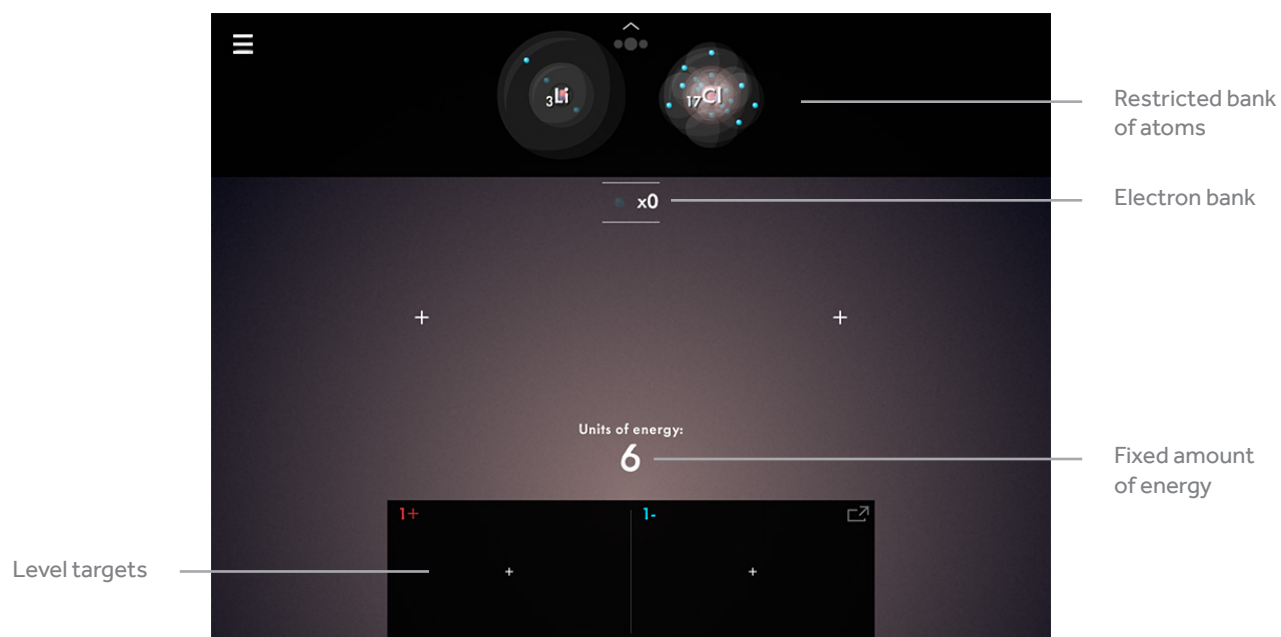
ATOMS to IONS CONNECTED LEVELS GOAL: Some atoms are missing from the bank. Use the button on the left to go to Atoms. Solve the Challenge and bring back the missing atoms!
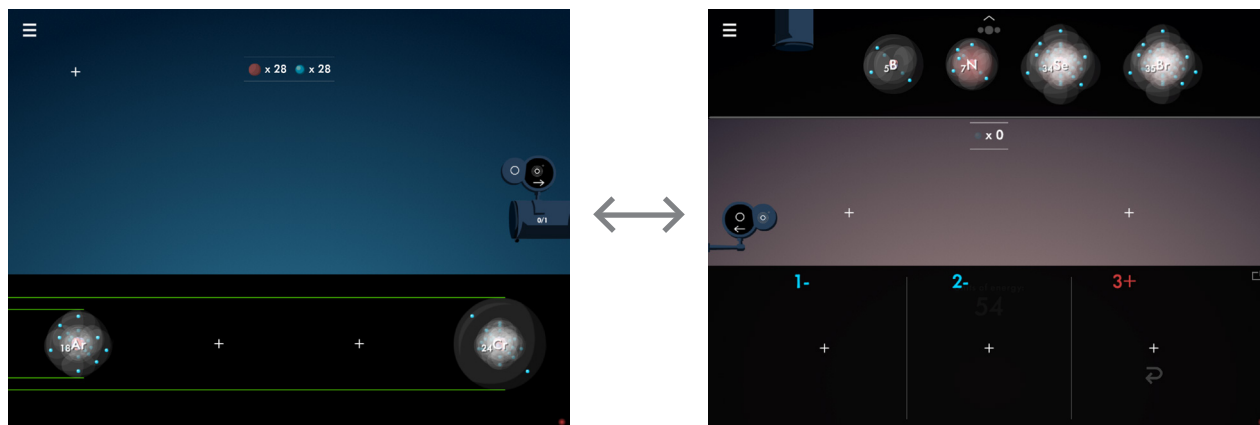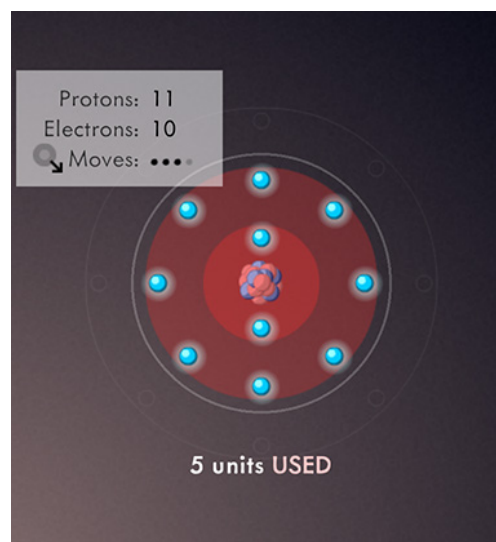
Ions: Chemistry Connections

CHEMISTRY CONCEPT: Cation formation

Player can form a positive ion (cation) by removing electrons from the valence shell.

Sodium (Na)

Sodium Ion (Na⁺)
valence electron removed

CHEMISTRY CONCEPT: Anion formation

Player can form a negative ion (anion) by adding electrons to the valence shell.
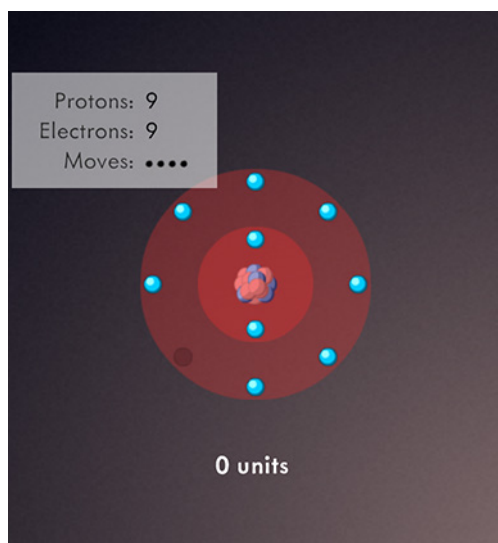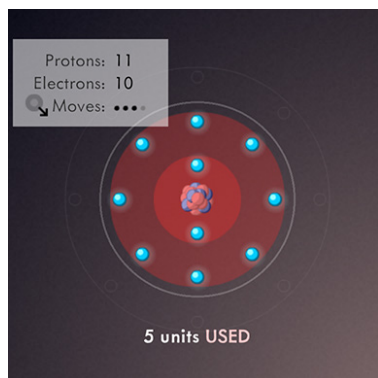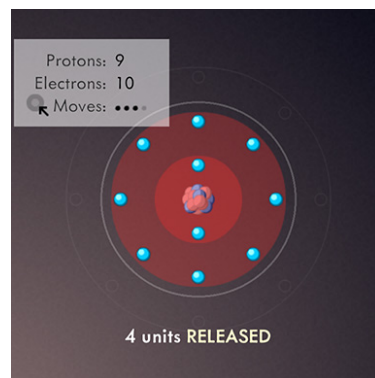

Fluorine (F)
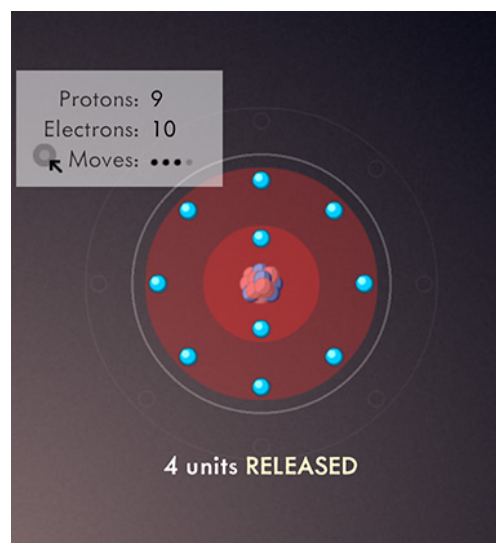
Fluoride (F⁺)
valence electron added

CHEMISTRY CONCEPT: **Octet rule**

Players can add or remove electrons to create a complete set of valence electrons.

Electron removed to satisfy
octet rule (8 valence electrons)

Electron added to satisfy octet
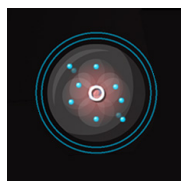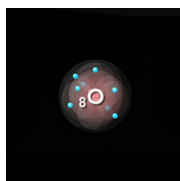rule (8 valence electrons)

CHEMISTRY CONCEPT: **Core electrons are held more strongly than valence electrons.**

Player will need more energy to remove an inner electron than a valence electron.
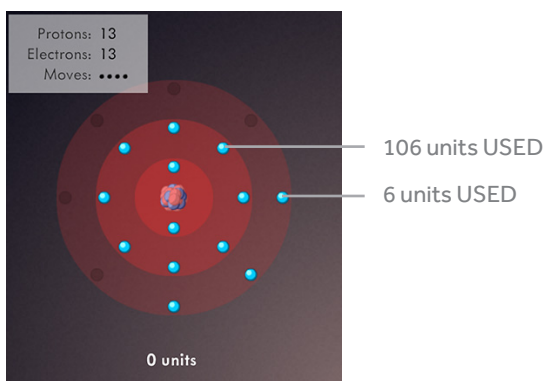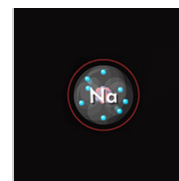

CHEMISTRY CONCEPT: **Ionic radii**

Player can observe difference in radii between ion and parent atom.

Anions are *larger* than their parent atoms.

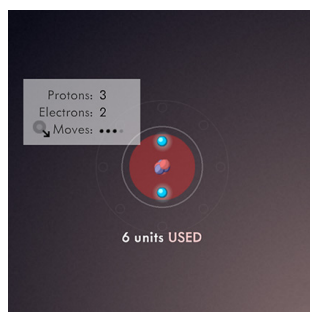Cations are *smaller* than their parent atoms.

Ions: Chemistry Connections (cont.)

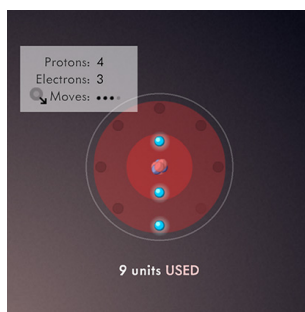CHEMISTRY CONCEPT: **Periodic trend: Ionization energy**

Player can observe that energy (ionization energy) is required to remove electrons from an atom.

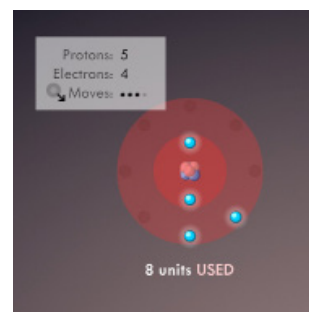Ionization energy increases across a period.

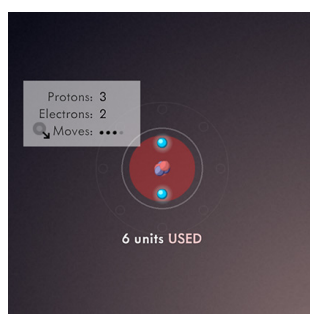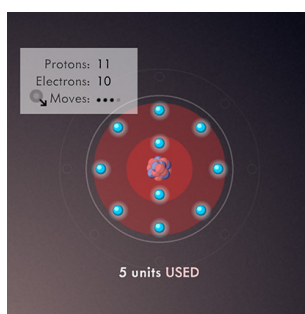Energy units used increase across Period II

Lithium

Beryllium

Boron

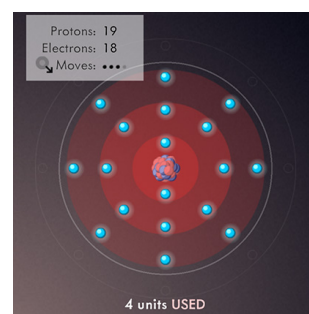Ionization energy decrease down a group.

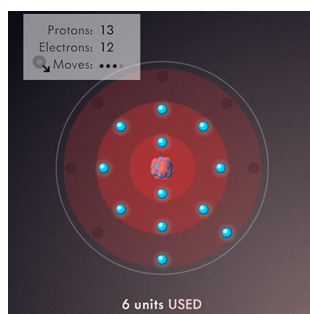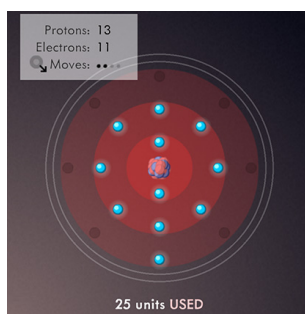Energy units used decrease across Group I

Lithium

Sodium

Potassium

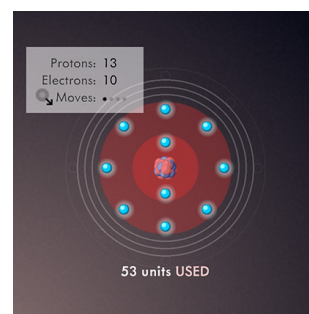Ionization energy increases upon removal of 2nd and 3rd electrons from an atom.

Energy units used increase upon removal of each valence electron from Aluminum

First Ionization Energy

Second Ionization Energy
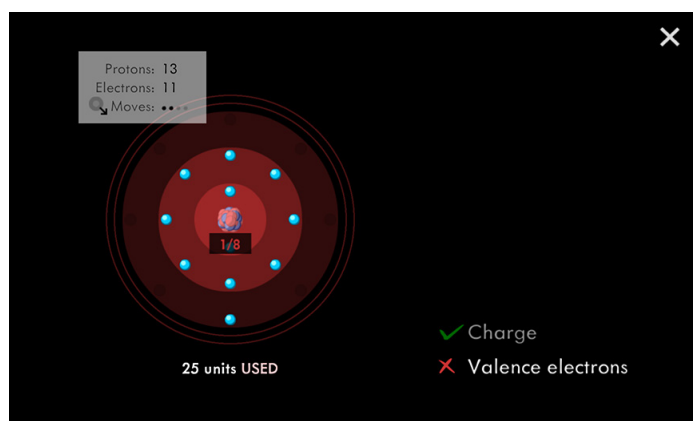

Third Ionization Energy

Ions: In-Game Feedback

Sandbox Check

- Add/Remove Mode

  Once an electron has been added or removed, the ion is locked into add or remove mode.

- Cannot Add/Remove more than 4 Electrons

  After adding/removing 4 electrons, the ion is locked.

- Valence Electron Check

  Octet rule must be satisfied.

Challenge Level Check

To check work in a challenge level, players can drag an 'ionization mode' atom to a chosen target. Ion will be checked against the target based on key chemistry content, as outlined below.

Incorrect

Correct