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# Warm-Up | Electrons and the Periodic Table

## Electron Configurations of Elements

Each _____ has a characteristic electron _____.

The simplest elements are hydrogen and helium:

- Hydrogen (H): $1s^1$
- Helium (He): $1s^2$

## Lesson Objectives

By the end of this lesson, you should be able to:

- Relate the _____ of an element in the periodic table to its electron configuration.
- Use the periodic table to determine the number of valence electrons available for bonding.

**Science Practice:** Analyze the relationship between electron configurations and the _____ of the periodic table.

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## Words to Know

*Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.*

_____ noble-gas notation

_____ core electrons

_____ valence electrons

_____ *s*-block elements

_____ *p*-block elements

_____ *d*-block elements

_____ *f*-block elements

A. the electrons that are found in the inner shells or lowest energy levels of an atom and not involved in reactions with other atoms

B. the electrons that are found in the outermost shell or highest energy levels of an atom and are responsible for determining the reactivity of the atom

C. a shorthand notation for writing the electron configuration for an element; substitutes the symbol of a noble gas to represent the configuration of inner shell electrons

D. the elements in which the final electron used to fill orbitals occupies a *d* orbital; transition elements in Groups 3 to 12

E. the elements in which the final electron used to fill orbitals occupies an *f* orbital; inner transition elements

F. the elements in which the final electron used to fill orbitals occupies an *s* orbital; elements in Groups 1 and 2

G. the elements in which the final electron used to fill orbitals occupies a *p* orbital; elements in Groups 13 to 18

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**Lesson Question**

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## The First Ten Elements and Noble-Gas Configuration

### Noble-gas notation

- Substitutes the [ ] of a noble gas to represent the configuration of inner shell electrons
- Shorthand [ ] for writing the electron configuration for an element

| Element | Electron Configuration |
|---|---|
| Hydrogen (H) | |
| Helium (He) | $1s^2$ |
| Lithium (Li) | $1s^2 2s^1$ |
| Beryllium (Be) | $1s^2 2s^2$ |
| Boron (B) | $1s^2 2s^2 2p^1$ |
| Carbon (C) | |
| Nitrogen (N) | $1s^2 2s^2 2p^3$ |
| Oxygen (O) | $1s^2 2s^2 2p^4$ |
| Fluorine (F) | $1s^2 2s^2 2p^5$ |
| Neon (Ne) | $1s^2 2s^2 2p^6$ |

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## Core and Valence Electrons in Periods 1-3

Example:

Phosphorus ( )

| | |
|---|---|
| $1s^2 2s^2 2p^6$ | $3s^2 3p^3$ |
| [Ne] | $3s^2 3p^3$ |
| core | valence |

Periods 1, 2, and 3

- Highest *n* = **valence electrons**
  - Electrons found in the shell or highest energy levels of an atom and responsible for determining the reactivity of the
  - Most and participate in bonding

Example:

Phosphorus (P)

| | |
|---|---|
| $1s^2 2s^2 2p^6$ | $3s^2 3p^3$ |
| [Ne] | $3s^2 3p^3$ |
| core | valence |

Periods 1, 2, and 3

- All interior orbitals/non valence = **core electrons**
  - Electrons found in the shells or lowest energy levels of an atom and not involved in reactions with other atoms
  - Stable and nonreactive
- Group number related to number of valence electrons
- Noble : full valence shell
  - configuration (2 or 8)

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## Core and Valence Electrons in Periods 4+

Example:

Cobalt ( [ ] )

| $1s^2 2s^2 2p^6 3s^2 3p^6$ | $4s^2 3d^7$ |
|---|---|
| core | |

Arsenic (As)

| $1s^2 2s^2 2p^6 3s^2 3p^6$ | $4s^2$ | $3d^{10}$ | $4p^3$ |
|---|---|---|---|
| core | | valence | |

Periods 4 and higher

- *s* and *p* orbitals with highest *n* = valence electrons
- Partially filled [ ] and *f* orbitals = valence electrons
- [ ] *d* and *f* orbitals = core electrons

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## Pathway of Filling Orbitals with Electrons

The order of filling orbitals is determined by the [ ] of the orbitals.

- Electrons always fill in order of increasing orbital energy.
- Trace the pathway of electron filling from left to [ ] in the periodic table.

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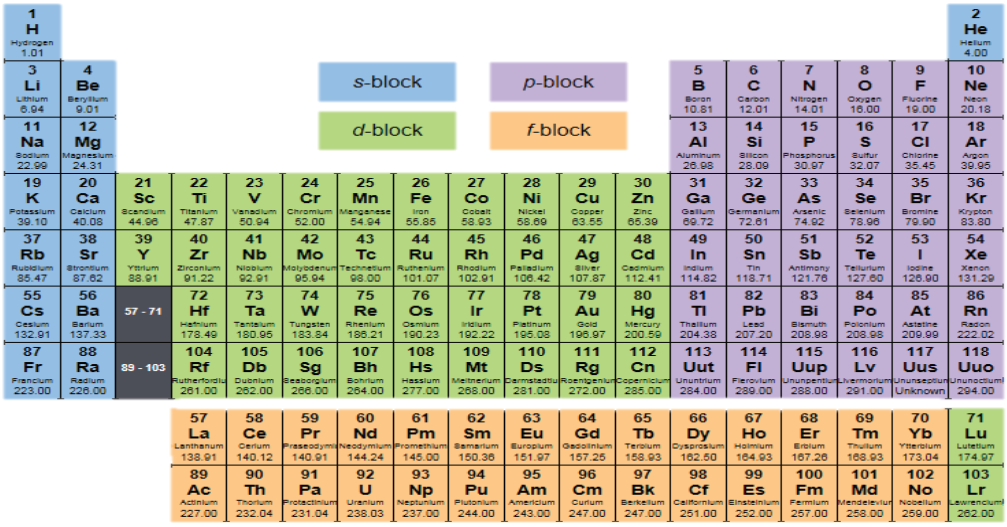
## Pathway of Filling Orbitals with Electrons




Hydrogen has one electron in the [ ] orbital. Then you go to the right to continue adding the next electron to make [ ] ($1s^2$). Moving from [ ] to right along each row, the pattern of filling [ ] orbitals is provided by the labels shown on the periodic table.

## *s*-Block, *p*-Block, *d*-Block, and *f*-Block Elements

Notice the [ ] colors used to make this periodic table image. These colors designate different regions of the periodic table that correspond to atomic [ ]. The regions include the *s*-block elements, [ ]-block elements, *d*-block elements, and *f*-block elements.

Each [ ] has an identity as an *s*-block, *p*-block, *d*-block, or *f*-block element.

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## *s*-Block Elements

The elements in the [ ] region are known as the *s*-block elements.

The *s*-block elements are groupss in which the final electron used to fill the orbitals occupies an *s* orbital, and these are elements in [ ] 1 and 2.

[ ] electrons in these elements, which are the electrons in the highest energy levels and most [ ] electrons, are located in the *s* orbitals.

The last electron to be added to an ***s*-block element** goes into an *s* orbital.

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## *p*-Block Elements

The *p*-block elements are elements in which the final electron used to [ ] orbitals occupies a *p* orbital. And these are elements in Groups 13 through 18.

Valence electrons in the *p*-block elements are located in both the [ ] and *p* orbitals.

The [ ] electron to be added to a ***p*-block element** goes into a *p* orbital.

## *p*-Block Elements Beyond Period 3

*p*-Block elements in periods [ ] or higher have valence electrons in [ ] orbitals as well as *s* and *p* orbitals.

The *p*-block elements in the first three [ ] are very straightforward to analyze, because their valence electrons occupy *s* and *p* orbitals only.

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## *d*-Block Elements

The elements in the _____ region are known as the *d*-block elements. The *d*-block elements are elements in which the final electron used to fill _____ occupies a *d* orbital. _____ elements in Groups 3 through 12 are *d* block.

The last electron to be added to a ***d*-block element** goes into an *d* orbital.

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## *f*-Block Elements

These are _____ transition elements. _____ electrons in *f*-block elements are located in the *s* and *f* orbitals.

The _____ electron to be added to an ***f*-block element** goes into an *f* orbital.

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## Exceptions

Chromium

- Predicted: [Ar]$4s^2 3d^4$
- Actual: [Ar] _____ $3d^5$
  - The *s* and *d* that are exactly _____ seems to be more stable.
- Mainly _____ metals

As in many situations in chemistry, there are exceptions to the general pattern of _____ orbitals.

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# Summary | Electrons and the Periodic Table

**Lesson Question**

How can the periodic table be used to understand the arrangement of electrons in an atom?

## Answer

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## Noble-Gas Notation

Electron [ ]

of neon

$1s^2 2s^2 2p^6 3s^2 3p^3$ → $[Ne]3s^2 3p^3$

Electron configuration of phosphorus

Substitute the [ ] for the appropriate noble gas

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## Core Electrons and Valence Electrons

Core electrons

- Found in the lowest energy levels of an atom
- Correspond to those of a [ ] gas and are generally nonreactive

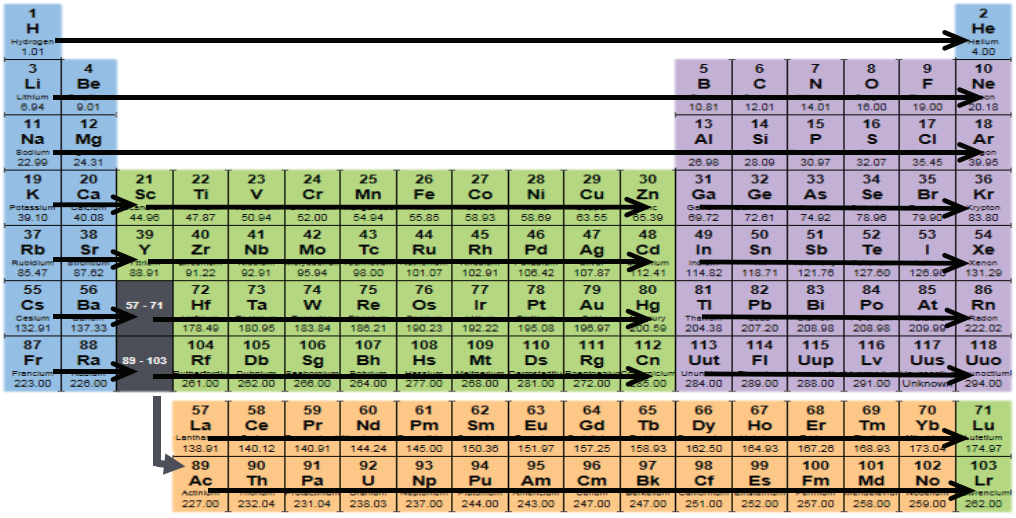
$1s^2 2s^2 2p^6$ — core

$3s^2 3p^3$ — valence

Valence electrons

- Found in the highest energy levels of an atom
- [ ] electrons; responsible for the atom's reactivity

## Using the Periodic Table to Determine Electron Configuration




Any element's electron configuration can be determined by keeping in mind that electrons fill orbitals in order of their increasing [ ].

The sequence of orbital filling follows a left to [ ] pattern across each row on the periodic table.

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*Use this space to write any questions or thoughts about this lesson.*

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