

# INTRODUCTION TO THE PERIODIC TABLE

(MODIFIED FOR ADEED)

## INSTRUCTIONS

### Science Concept:

Information on the periodic table can be used to determine the proton, neutron, and electron count of atoms, and vice versa.

### Objectives:

The student will:

- classify elements into the periodic table; and
- determine information about an element (atomic mass, atomic number, symbol, etc.) from the Periodic Table of Elements.

### GLEs Addressed:

#### Science

[10] SB1.1 The student demonstrates an understanding of the structure and properties of matter by using the periodic tables to describe atoms in terms of their base components (i.e., protons, neutrons, electrons).

[10-11] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

### Vocabulary:

**atom** – a tiny particle

**atomic mass** – the mass of any kind of atom usually expressed in atomic mass units

**electron** – an elementary particle that has a negative charge of electricity and travels around the nucleus of an atom

**element** – a pure substance made up of only one kind of atom (ex: Gold)

**neutron** – an uncharged atomic particle that has a mass nearly equal to that of the proton and is present in all known atomic nuclei except the hydrogen nucleus

**nucleus** – the central part of an atom that includes nearly all of the atomic mass and consists of protons and usually neutrons

**Periodic Table of Elements** – a tabular method of displaying the chemical elements

**proton** – an atomic particle that occurs in the nucleus of every atom and carries a positive charge equal in size to the negative charge of an electron

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**NOTE:** These vocabulary words are for teacher use only.

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### Materials:

- Aluminum foil
- Index cards (20)
- STUDENT INFORMATION SHEET: "Periodic Table of Elements" (one per student)
- TEACHER INFORMATION SHEET: "Definitions and Examples of Leading Questions"
- STUDENT WORKSHEET: "Introduction to the Periodic Table"

**Activity Preparation:**

1. Create a card for each of the first 20 elements. Each card should contain the following information (see example, below): element name, element symbol, atomic number, number of protons, number of electrons, number of neutrons, atomic mass, and atomic charge.

|                                       |                                      |
|---------------------------------------|--------------------------------------|
| <b>Hydrogen</b>                       | <b>H</b>                             |
| Atomic Number =<br><b>1</b>           | Atomic Mass =<br><b>1 amu</b>        |
| Number of (+) Protons =<br><b>1</b>   | Number of (0) Neutrons =<br><b>0</b> |
| Number of (-) Electrons =<br><b>1</b> | Charge =<br><b>0</b>                 |

2. Create a grid of the periodic table that includes only the first 20 elements. Make sure the grid squares are large enough for the cards created in Activity Preparation #1. Make copies and place one at each student workstation.

**Activity Procedure:****Gear Up****Process Skills: observing, predicting, describing, and communicating**

1. Show students a sheet of aluminum foil. Ask students to describe the properties of the foil. Tear the sheet of foil in half. Ask students if the physical properties of both pieces are the same.
2. Tear one of the halves into two smaller pieces and ask students if the physical properties are still the same. Repeat the demonstrate and question until the sheet cannot be torn into smaller pieces.
3. Ask students what aluminum is (*element*). Ask students what the smallest particle of the element is called (*atom*).

**Explore****Process Skills: observing, asking questions, predicting, classifying, making generalizations, analyzing data, exploring models, and communicating**

4. Explain that the Periodic Table of Elements is a tool used by chemists and other scientists to find out information concerning the atoms of elements. Distribute the cards made during the Activity Preparation and point out the empty periodic table on their workstations. Explain that students should design their own periodic table by placing the cards on the blank periodic table.
5. Work with students to perfect their periodic tables.

**Generalize****Process Skills: making generalizations, analyzing data, communicating, observing, and asking questions**

6. Ask students to try to identify any trends they see with the information on the various cards. Discuss with them. For example, ask students what trends they see in regard to the atomic numbers of the elements. What are some equalities we could write for a neutral (chargeless) atom? For example, # of protons = # of electrons; # protons + # of neutrons = atomic mass.

7. Make sure to enter the vocabulary words into the classroom discussion.

### **Apply/Assess**

#### ***Process Skill: analyzing data***

8. Pass out the STUDENT INFORMATION SHEET: "Periodic Table of Elements" and briefly review the location of the atomic number, average atomic mass, and any other symbols or coding on the table.
9. Distribute the STUDENT WORKSHEET: "Introduction to the Periodic Table" and rubric. Reminded student that their calculation may not agree with the number on the table since the number on the table is an AVERAGE.

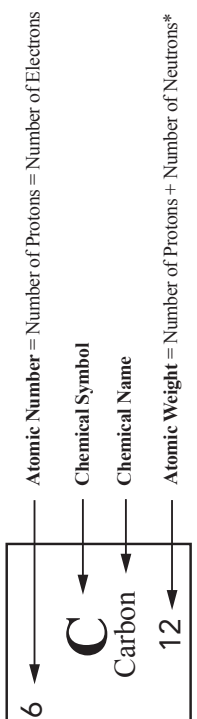
# INTRODUCTION TO THE PERIODIC TABLE

# RUBRIC

| <b>Objective</b>  | <b>GLE</b> | <b>Emergent</b>   | <b>Developing</b>   | <b>Proficient</b>  | <b>Advanced</b>   |
|---|------------|---|---|--|---|
| The student answers questions on the worksheet correctly. | [10] SB1.1 | The student does not complete the worksheet or answers all questions incorrectly. | The student answers less than seven questions on the worksheet correctly. | The student answers between 7 and 16 questions on the worksheet correctly. | The student answers between 17 and 23 questions on the worksheet correctly.             |
| The student classifies elements into the periodic table.  | [10] SA1.1 | The student does not classify any elements.                                       | The student successfully classifies some elements, but not all.           | The student successfully classifies all the elements.                      | The student successfully classified all the elements and explains his or her reasoning. |

# The Periodic Table of Elements

|                             |                             |                              |                                   |                             |                                |                              |                              |                                |                                  |                                 |                               |                                |                                  |                                  |                                 |   |                                 |                            |                          |
|-----------------------------|-----------------------------|------------------------------|-----------------------------------|-----------------------------|--------------------------------|------------------------------|------------------------------|--------------------------------|----------------------------------|---------------------------------|-------------------------------|--------------------------------|----------------------------------|----------------------------------|---------------------------------|---|---------------------------------|----------------------------|--------------------------|
| <b>NON-METALS</b>           |                             |                              |                                   |                             |                                |                              |                              |                                |                                  |                                 |                               |                                |                                  |                                  |                                 |   |                                 |                            |                          |
| 1<br>H<br>Hydrogen<br>1     | 2<br>He<br>Helium<br>4      |                              |                                   |                             |                                |                              |                              |                                |                                  |                                 |                               |                                |                                  |                                  |                                 |   |                                 |                            |                          |
| 3<br>Li<br>Lithium<br>7     | 4<br>Be<br>Beryllium<br>9   | 5<br>B<br>Boron<br>11        | 6<br>C<br>Carbon<br>12            | 7<br>N<br>Nitrogen<br>14    | 8<br>O<br>Oxygen<br>16         | 9<br>F<br>Fluorine<br>19     | 10<br>Ne<br>Neon<br>20       |                                |                                  |                                 |                               |                                |                                  |                                  |                                 |   |                                 | 17<br>Cl<br>Chlorine<br>35 | 18<br>Ar<br>Argon<br>40  |
| 11<br>Na<br>Sodium<br>23    | 12<br>Mg<br>Magnesium<br>24 | 13<br>Al<br>Aluminum<br>27   | 14<br>Si<br>Silicon<br>28         | 15<br>P<br>Phosphorus<br>31 | 16<br>S<br>Sulfur<br>32        | 33<br>As<br>Arsenic<br>75    | 34<br>Se<br>Selenium<br>79   | 35<br>Br<br>Bromine<br>80      | 36<br>Kr<br>Krypton<br>84        |                                 |                               |                                |                                  |                                  |                                 |   |                                 | 53<br>I<br>Iodine<br>127   | 54<br>Xe<br>Xenon<br>131 |
| 19<br>K<br>Potassium<br>39  | 20<br>Ca<br>Calcium<br>40   | 21<br>Sc<br>Scandium<br>45   | 22<br>Ti<br>Titanium<br>48        | 23<br>V<br>Vanadium<br>51   | 24<br>Cr<br>Chromium<br>52     | 25<br>Mn<br>Manganese<br>55  | 26<br>Fe<br>Iron<br>56       | 27<br>Co<br>Cobalt<br>59       | 28<br>Ni<br>Nickel<br>59         | 29<br>Cu<br>Copper<br>64        | 30<br>Zn<br>Zinc<br>65        | 31<br>Ga<br>Gallium<br>70      | 32<br>Ge<br>Germanium<br>73      | 33<br>As<br>Arsenic<br>75        | 34<br>Se<br>Selenium<br>79      | 35<br>Br<br>Bromine<br>80                     | 36<br>Kr<br>Krypton<br>84       |                            |                          |
| 37<br>Rb<br>Rubidium<br>85  | 38<br>Sr<br>Strontium<br>88 | 39<br>Y<br>Yttrium<br>89     | 40<br>Zr<br>Zirconium<br>91       | 41<br>Nb<br>Niobium<br>93   | 42<br>Mo<br>Molybdenum<br>96   | 43<br>Tc<br>Technetium<br>98 | 44<br>Ru<br>Ruthenium<br>101 | 45<br>Rh<br>Rhodium<br>103     | 46<br>Pd<br>Palladium<br>106     | 47<br>Ag<br>Silver<br>108       | 48<br>Cd<br>Cadmium<br>112    | 49<br>In<br>Indium<br>115      | 50<br>Sn<br>Tin<br>119           | 51<br>Sb<br>Antimony<br>122      | 52<br>Te<br>Tellurium<br>128    | 53<br>I<br>Iodine<br>127                      | 54<br>Xe<br>Xenon<br>131        |                            |                          |
| 55<br>Cs<br>Cesium<br>133   | 56<br>Ba<br>Barium<br>137   | 57<br>La<br>Lanthanum<br>139 | 72<br>Hf<br>Hafnium<br>178        | 73<br>Ta<br>Tantalum<br>181 | 74<br>W<br>Tungsten<br>184     | 75<br>Re<br>Rhenium<br>186   | 76<br>Os<br>Osmium<br>190    | 77<br>Ir<br>Iridium<br>192     | 78<br>Pt<br>Platinum<br>195      | 79<br>Au<br>Gold<br>197         | 80<br>Hg<br>Mercury<br>201    | 81<br>Tl<br>Thallium<br>204    | 82<br>Pb<br>Lead<br>207          | 83<br>Bi<br>Bismuth<br>209       | 84<br>Po<br>Polonium<br>209     | 85<br>At<br>Astatine<br>210                   | 86<br>Rn<br>Radon<br>222        |                            |                          |
| 87<br>Fr<br>Francium<br>223 | 88<br>Ra<br>Radium<br>226   | 89<br>Ac<br>Actinium<br>227  | 104<br>Rf<br>Rutherfordium<br>267 | 105<br>Db<br>Dubnium<br>268 | 106<br>Sg<br>Seaborgium<br>271 | 107<br>Bh<br>Bohrium<br>272  | 108<br>Hs<br>Hassium<br>277  | 109<br>Mt<br>Meitnerium<br>276 | 110<br>Ds<br>Darmstadtium<br>281 | 111<br>Rg<br>Roentgenium<br>280 | 112<br>Uub<br>Ununbium<br>285 | 113<br>Uut<br>Ununtrium<br>284 | 114<br>Uuq<br>Ununquadium<br>289 | 115<br>Uup<br>Ununpentium<br>288 | 116<br>Uuh<br>Ununhexium<br>291 | 117<br>Uus<br>Ununseptium<br>not yet observed | 118<br>Uuo<br>Ununoctium<br>294 |                            |                          |



## METALS

|                              |                           |                                 |                              |                               |                             |                              |                               |                            |                               |                            |                           |                            |                              |                             |                             |                            |                                 |                           |                              |                              |                              |                           |                              |                                |                                |                             |                                 |                              |                                |
|------------------------------|---------------------------|---------------------------------|------------------------------|-------------------------------|-----------------------------|------------------------------|-------------------------------|----------------------------|-------------------------------|----------------------------|---------------------------|----------------------------|------------------------------|-----------------------------|-----------------------------|----------------------------|---------------------------------|---------------------------|------------------------------|------------------------------|------------------------------|---------------------------|------------------------------|--------------------------------|--------------------------------|-----------------------------|---------------------------------|------------------------------|--------------------------------|
| <b>KEY</b>                   |                           |                                 |                              |                               |                             |                              |                               |                            |                               |                            |                           |                            |                              |                             |                             |                            |                                 |                           |                              |                              |                              |                           |                              |                                |                                |                             |                                 |                              |                                |
| ●                            | ▲                         | ▲                               | ▲▲                           | ●                             |                             |                              |                               |                            |                               |                            |                           |                            |                              |                             |                             |                            |                                 |                           |                              |                              |                              |                           |                              |                                |                                |                             |                                 |                              |                                |
| ●                            | ▲                         | ▲                               | ▲▲                           | ●                             | = Solid at room temperature | = Liquid at room temperature | = Gas at room temperature     | = Radioactive              | = Artificially Made           |                            |                           |                            |                              |                             |                             |                            |                                 |                           |                              |                              |                              |                           |                              |                                |                                |                             |                                 |                              |                                |
| 57<br>La<br>Lanthanum<br>139 | 58<br>Ce<br>Cerium<br>140 | 59<br>Pr<br>Praseodymium<br>141 | 60<br>Nd<br>Neodymium<br>144 | 61<br>Pm<br>Promethium<br>145 | 62<br>Sm<br>Samarium<br>150 | 63<br>Eu<br>Europium<br>152  | 64<br>Gd<br>Gadolinium<br>157 | 65<br>Tb<br>Terbium<br>159 | 66<br>Dy<br>Dysprosium<br>163 | 67<br>Ho<br>Holmium<br>165 | 68<br>Er<br>Erbium<br>167 | 69<br>Tm<br>Thulium<br>169 | 70<br>Yb<br>Ytterbium<br>173 | 71<br>Lu<br>Lutetium<br>175 | 89<br>Ac<br>Actinium<br>227 | 90<br>Th<br>Thorium<br>232 | 91<br>Pa<br>Protactinium<br>231 | 92<br>U<br>Uranium<br>238 | 93<br>Np<br>Neptunium<br>237 | 94<br>Pu<br>Plutonium<br>244 | 95<br>Am<br>Americium<br>243 | 96<br>Cm<br>Curium<br>247 | 97<br>Bk<br>Berkelium<br>247 | 98<br>Cf<br>Californium<br>251 | 99<br>Es<br>Einsteinium<br>252 | 100<br>Fm<br>Fermium<br>257 | 101<br>Md<br>Mendelevium<br>258 | 102<br>No<br>Nobelium<br>259 | 103<br>Lr<br>Lawrencium<br>262 |

\*The atomic weights listed on this Table of Elements have been rounded to the nearest whole number. As a result, this chart actually displays the mass number of a specific isotope for each element. An element's complete, unrounded atomic weight can be found on the IUPAC's Elemental web site: <http://education.jlab.org/itselemental/index.html>

Modified from: <http://education.jlab.org>

NAME: \_\_\_\_\_

INTRODUCTION TO THE PERIODIC TABLE

**Directions:** Fill in the blanks by looking at the periodic table and your notes from the class discussion. Show work as necessary.

|                     |       |     |
|---------------------|-------|-----|
| 1. Element          | Neon  |     |
| Chemical Symbol     | _____ |     |
| Atomic Mass         | _____ | amu |
| Atomic Number       | _____ |     |
| Number of Protons   | _____ |     |
| Number of Electrons | _____ |     |
| Number of Neutrons  | 10    |     |
| Charge of Atom      | 0     |     |

|                     |       |     |
|---------------------|-------|-----|
| 2. Element          |       |     |
| Chemical Symbol     | Cr    |     |
| Atomic Mass         | 52    | amu |
| Atomic Number       | _____ |     |
| Number of Protons   | 24    |     |
| Number of Electrons | _____ |     |
| Number of Neutrons  | _____ |     |
| Charge of Atom      | 0     |     |

|                     |          |     |
|---------------------|----------|-----|
| 3. Element          | Nitrogen |     |
| Chemical Symbol     | _____    |     |
| Atomic Mass         | 14       | amu |
| Atomic Number       | 7        |     |
| Number of Protons   | _____    |     |
| Number of Electrons | _____    |     |
| Number of Neutrons  | _____    |     |
| Charge of Atom      | 0        |     |

|                     |       |     |
|---------------------|-------|-----|
| 4. Element          |       |     |
| Chemical Symbol     | Li    |     |
| Atomic Mass         | 7     | amu |
| Atomic Number       | _____ |     |
| Number of Protons   | _____ |     |
| Number of Electrons | 3     |     |
| Number of Neutrons  | _____ |     |
| Charge of Atom      | 0     |     |

|                     |        |     |
|---------------------|--------|-----|
| 5. Element          | Helium |     |
| Chemical Symbol     | _____  |     |
| Atomic Mass         | _____  | amu |
| Atomic Number       | _____  |     |
| Number of Protons   | 2      |     |
| Number of Electrons | _____  |     |
| Number of Neutrons  | 2      |     |
| Charge of Atom      | 0      |     |

|                     |       |     |
|---------------------|-------|-----|
| 6. Element          |       |     |
| Chemical Symbol     | _____ |     |
| Atomic Mass         | 45    | amu |
| Atomic Number       | 21    |     |
| Number of Protons   | _____ |     |
| Number of Electrons | _____ |     |
| Number of Neutrons  | _____ |     |
| Charge of Atom      | 0     |     |

|                     |       |     |
|---------------------|-------|-----|
| 7. Element          |       |     |
| Chemical Symbol     | _____ |     |
| Atomic Mass         | _____ | amu |
| Atomic Number       | _____ |     |
| Number of Protons   | 57    |     |
| Number of Electrons | _____ |     |
| Number of Neutrons  | 80    |     |
| Charge of Atom      | 0     |     |

|                     |       |     |
|---------------------|-------|-----|
| 8. Element          |       |     |
| Chemical Symbol     | _____ |     |
| Atomic Mass         | _____ | amu |
| Atomic Number       | _____ |     |
| Number of Protons   | _____ |     |
| Number of Electrons | 18    |     |
| Number of Neutrons  | 22    |     |
| Charge of Atom      | 0     |     |

|                     |        |     |
|---------------------|--------|-----|
| 9. Element          | Silver |     |
| Chemical Symbol     | _____  |     |
| Atomic Mass         | 108    | amu |
| Atomic Number       | _____  |     |
| Number of Protons   | _____  |     |
| Number of Electrons | _____  |     |
| Number of Neutrons  | _____  |     |
| Charge of Atom      | 0      |     |

|                     |       |     |
|---------------------|-------|-----|
| 10. Element         |       |     |
| Chemical Symbol     | U     |     |
| Atomic Mass         | 238   | amu |
| Atomic Number       | _____ |     |
| Number of Protons   | _____ |     |
| Number of Electrons | _____ |     |
| Number of Neutrons  | _____ |     |
| Charge of Atom      | 0     |     |

**Definitions**

**Element** – A pure substance made up of only one kind of atom (ex: gold).

Elements are given a unique name and symbol to represent their name in chemical formulas. They may react with other elements to make a new material with properties that are not similar to the original elements (ex: Water [in liquid form] is composed of the elements Hydrogen [gas] and Oxygen [gas]).

**Atom** – The smallest unit of an element that can exist.

Atoms are a basic building block of matter. They contain electrons, protons, and, in most cases, neutrons. They have no charge unless an electron has been added or removed; then they are called an ion.

**Proton** – A subatomic particle of an atom.

Protons are positively charged. They are located in the nucleus of the atom. They have a definite mass that is roughly equal to that of a neutron. For every proton, there has to be an electron for the atom to remain uncharged (neutral).

**Neutron** – A subatomic particle of an atom.

A neutron has no charge. It is located in the nucleus of the atom. It has a definite mass that is roughly equal to that of a proton. Only one element in its most common form does not have any neutrons (Hydrogen).

**Nucleus** – The center of the atom.

The nucleus of an atom contains the protons and neutrons (if any). Is surrounded by the electrons.

**Electron** – A subatomic particle of an atom.

Electrons have a negative charge. They are located all around the nucleus of the atom. For every proton, there has to be an electron for the atom to remain uncharged (neutral). If an electron has been removed or added, the atom becomes charged (removed it is positively charged; added it is negatively charged). Electrons are always in movement around the nucleus. They have little mass compared to protons or neutrons.

**Atomic Number** – The number of protons in the nucleus.

Each element has a unique atomic number.

**Atomic Mass** – The sum of the protons and neutrons in the nucleus.

**Examples of Leading Question:**

- What types of trends do you see with the atomic number?
- Does each element have a unique atomic number?
- How does the atomic number relate to the number of protons?
- How does the atomic mass relate to the number of neutrons and protons?
- How come we have no charge in the atom, but have positive protons and negative electrons?
- Do the neutrons have a charge?
- What is an equation we could write for the atomic mass?
- Does the mass of the electron play a part in the atomic mass? What does that tell you about the mass of the electron relative to the mass of the proton or neutron?
- What are some equalities we could write for a neutral (chargeless) atom?