



## Game Phase One SOLIGA™ Lesson Plan

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### HOW TO USE GAME PHASE ONE LESSON PLAN

This page and the next 3 pages are facilitator instructions. Pages 6-14 are handouts that can be copied for one-on-one, small group, or total class instruction. The lesson is broken down into recommended sequential steps. As mentioned in the lesson plans overview page, use only the 111 card deck of *Science fusion*™, *the Elements of the Scientists*™ game. To simplify game play, Mole cards are not used. See rules for more details. T-Bone dice and Electrocoins are not needed.

**LESSON PLAN ONE**  
**Game Phase SOLIGA™**  
**Grades:** 3<sup>rd</sup> and up  
**Objectives:** Element vocabulary, abbreviations, and atomic number; States of matter; and Periodic table groupings.

#### STEP 1: Activating, Assessing, & Developing Participants' Prior Knowledge

Materials: White/chalk board or butcher paper and writing materials for small groups may be desirable.

Objective: Participants will discuss and write essential vocabulary dealing with chemistry and elements.

Discussion and Activities:

a) Discussion: Write out and/or ask the following questions and have participants answer aloud in turn or have them write responses in small groups to be shared with the entire group. Facilitate responses to Part 1 before proceeding to Part 2.

#### Part 1

1. What is Chemistry?
2. How do we use chemistry?

#### Part 2

1. What is an element?
2. What are atoms, molecules, and compounds?

b) Presentation - Element Facts: After discussion, present the following facts verbally and if possible, with accompanying writing on a white/chalk board or butcher paper. Acknowledge groups'/individual's prior knowledge shared during discussion that matches the presented facts. (As an option, participants could copy the notes in journals and, with facilitator prompting, evaluate why Chemistry is important).

- All matter is made up of elements.
- An **element** is made-up of one or more atoms that have the same number of protons.
- Some elements have one atom, such as helium.
- Elements with more than one atom are called **molecules**.
- **Atoms** are made-up of three parts:
  - **Protons:** A **positively** charged subatomic particle;
  - **Neutrons:** An electrically **neutral** subatomic particle; and
  - **Electrons:** A **negatively** charged subatomic particle.
- Electrons and protons are attracted to each other and are equal in electrical strength but do not have the same mass.

- Protons and electrons are NOT attracted to neutrons.
- The **mass** of an atom is mostly made-up of protons and neutrons gathered in a **nucleus** that carries a positive charge.
- Electrons move around the nucleus and are 1,840 times smaller in mass than protons and neutrons.
- The **volume** or space an atom occupies is mostly taken up by electrons.
- Elements can be combined to make **compounds** such as water - H<sub>2</sub>O (2 parts hydrogen and 1 part oxygen).
- An atom is stable when the number of electrons and protons of equal but opposite charges are kept in balance.
- Compounds or chemical reactions are most easily created by adding or removing electrons and disrupting the balance of the positive and negative charge.

## STEP 2: Exploring States of Matter

Materials: 111 element character cards. \* Copies of page 6, the Soliga™ Play Mat for each participant. \* White/chalk board or butcher paper and writing materials for small groups or individuals.

Objective: Participants will discuss, write, and discover that all matter can exist as a gas, liquid, or solid.

### Discussion and Activities:

a) **Form Groups:** Place participants into groups of 1 player versus 1 player but when instructing participants numbering greater than 26 individuals, group participants into teams of 2 players versus 2 players. Provide each participant or team with writing materials.

b) **Brainstorming:** For 4-8 minutes have participants individually or in groups brainstorm in a three-column chart on substances that can be in the form of gas,

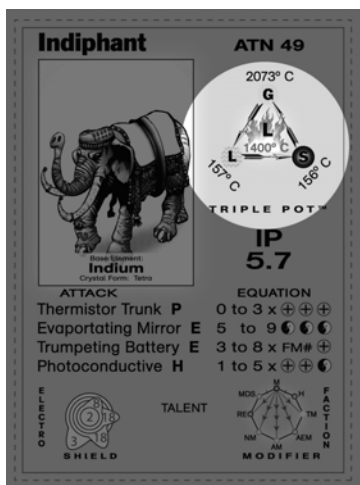
liquid, or solid. Next have participants share their lists while making note of any shared elements on the white/chalk board or butcher paper. It is perfectly fine if participants list substances that are not elements such as water but be sure to mention at some point that **all substances can be broken down into elements**. For example, water is a combination of hydrogen and oxygen. Give praise to those who list elements and to those who realize that all matter can exist in all three forms. Be sure to emphasize that **all matter can exist as a gas, liquid, or solid**. For example, not all people realize that gold can be heated to temperatures that turn it into gas.

c) **Guided Instruction:** Pass out the Soliga™ Play Mat shown below and draw students' attention to and discuss the temperature facts in the lower right hand corner of the paper.

The game is played with elements heated up to 1400° Celsius that are listed as abbreviations on the bottom left half of the paper. At some point mention the fact that at **room temperature** there are only 2 elements in a liquid state (Hg and Br), 11 in a gas state (H, He, N, O, F, Ne, Cl, Ar, Kr, Xe, Rn) and the remaining elements are solid or are presumed solid, i.e., some man made, synthetic elements have not existed in enough quantity to be sure.

d) **Activity - Play Soliga™:** Randomly shuffle the deck and provide 4-10 element character cards for each participant or team.

e) Card Review: Have participants look at the front side of their cards and emphasis that only **Triple Pot™** is used in this phase of the game as highlighted on the next page and enlarged on the play mat.



f) Rules Instruction: Go over the rules shown on the play mat. Mention that the game is played like ‘rock-paper-scissors’. Players place their element character cards face down with the back (character side face up) on the ‘Draw Pile’ space on their mat. Then each player flips up one card and compares the element’s state of matter located in the center of the Triple Pot™. As shown on the play mat, solid beats gas, gas beats liquid, and liquid beats solid. Only the player who wins the comparison places his/her element character cards in the ‘Won Pile’ with the losing player removing his/her cards out of the game. Both players place their element character cards on the ‘Won Pile’ when states are the same.

For example, Rubidragon beats Goldluster (gas beats liquid). The player with Rubidragon places it on his/her ‘Won Pile’ and the player with Goldluster removes it from the game.

After flipping and comparing all element character cards, the player with the most cards in the ‘Won Pile’ wins. As a variant, play the

game like ‘War’ where players capture cards and win the most cards after so many rounds.

Please note that elements with an ‘A’ are man made, synthetic elements that have not existed long enough to determine what temperatures will make them a solid, liquid, or gas. A card flipped with an ‘A’ results in a tie where both players place their element character cards in the ‘Won’ Pile.

### STEP 3: Computing Atomic Number

Materials: 111 element character cards. \*  
Copies of pages 7-13 for each participant or group.

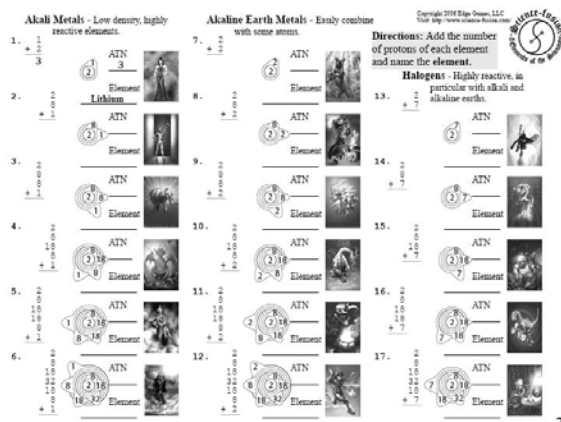
Objective: Participants will correctly calculate elements’ atomic numbers and understand that the total number of protons at an element’s nucleus defines an element and that a stable atom has an equal number of electrons and protons.

#### Discussion and Activities:

a) Discussion: Before introducing the second phase of the game in lesson two, participants should understand how an element’s atomic number is calculated and that it corresponds to how the elements are laid out on the periodic table as explored in step 4. Notice that participants will actually be counting electrons represented in **valence** shells, not protons in an element’s nucleus. This fact will come into play in the second phase of the game that also happens to deal with a fundamental chemistry concept of making compounds. For now, emphasize that the atomic number is based on the number of protons in a nucleus that also determines the number of electrons in an element’s valence shells.

b) Pass Out ATN Sheets: As shown as a sample on the next page, pass out pages 7-13 for individuals or groups to complete. Have students check their answers with the *Science*

*fusion*<sup>TM</sup> card deck. Consider presorting the deck into groups that match each ATN sheet.



Participants may notice that the pages are grouped by element families/game factions to aid in memorizing the periodic table of elements in Step 4.

#### STEP 4: Memorizing the Periodic Table of Elements

**Materials:** 111 element character cards. \*  
Copies of page 14 for each participant. \*  
Writing utensils.

**Objective:** Through various activities participants will memorize the atomic number and abbreviations of 111 elements on the periodic table.

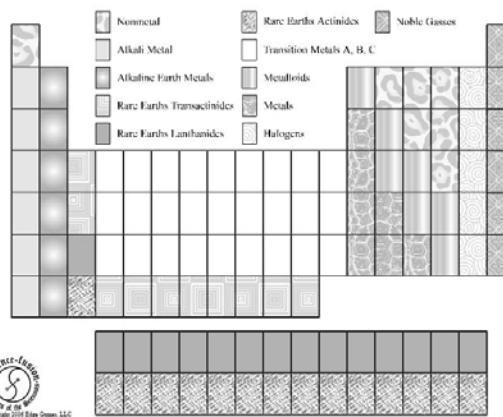
#### Discussion and Activities:

a) Discussion: Just as learning multiplication facts is essential to more advanced math, learning the abbreviations and atomic numbers is crucial to secondary level chemistry classes. There may be some differences in abbreviations and names when comparing *Science fusion*<sup>TM</sup> cards 110 and 111 with outside resources. Also, note that some tables list 116 elements with more added every year or two.

b) **Activity - Make a Study Key:** Using an encyclopedia or Edge Games' interactive website

<http://www.science-fusion.com/poster/index.html>

as a reference, have participants create a study key by filling in the boxes on page 14 (shown below) with element abbreviations and corresponding atomic numbers.



c) **Activity - Group Quiz:** Give each participant or team a copy of page 14 above and a pencil. As the facilitator, draw cards from the *Science fusion*<sup>TM</sup> deck and state its element name as found on the front card side in the character box. Participants must correctly write the abbreviation and atomic number in the correct box. Consider playing in reverse and only give the abbreviation. Play until all cards have been drawn. The 'winner' is the player with most correct answer boxes.

d) **Activity - Element Families:** In groups of 2 to 8, play Rummy and Go Fish by matching element families/factions in Go Fish or making sequences of atomic numbers or family/faction groupings in Rummy. Players will need a completed Study Key as reference.