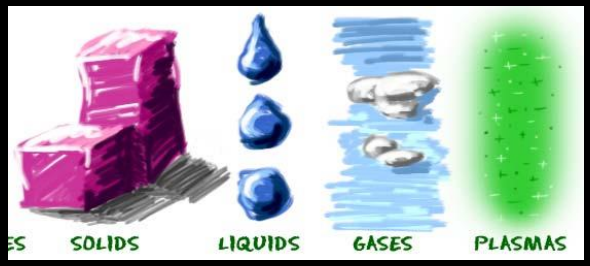
UNIT 2: Matter and its changes

Mrs. Turner

Preassessment

- Take out a sheet of paper and number it from 1-25.
- Write down your answers to plug them into your clickers.
- Don’t worry about not knowing an answer you will know them all by the end of this 9 weeks. Work at a good pace. We have a few things on our agenda.

Matter



- Anything that has mass and takes up space.
- Examples: Gas (air- mixture of gases), hand, bones, astronaut suit.

SO PRETTY MUCH EVERYTHING!!!

Well….. Except for sound and light (we'll get to this later!)

Atomic Structure

What is an atom?

- **Atom:** the smallest unit of matter that retains the identity of the substance.
- Which means, these tiny particles make up matter. Even though they make up matter, they still have the same properties (i.e. smell-odor, taste, color, etc).

Gold (Au)

Cut gold into fragments of gold. Those fragments into the smallest piece (hypothetically) these would be the gold atoms.

Just how small is an atom?

- https://www.youtube.com/watch?v=yQP4UJhNn0I

Atomic Structure

- The inside of the atom is called its structure. The atom's structure is made of 3 elementary particles, the neutron, electron, and the proton.
- An elementary particle cannot be broken down any further.
- Matter (Solid, liquid, gas)~Atoms ~Elementary particles (Subatomic)

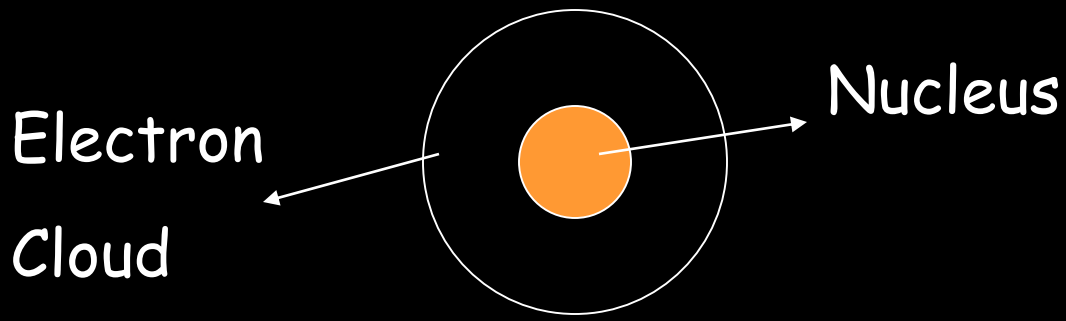
10/15/15 Warm up

- What is matter?
- What is an atom?

- Did you know that atoms are about 10 -10 meters in diameter? This means you could fit millions of atoms in the period at the end of this sentence!

Atomic Structure

- Atoms have 2 regions
  1) **Nucleus**: the center of the atom that contains *most of the mass* of the atom.
  2) **Electron cloud**: surrounds the nucleus & takes up *most of the space* of the atom.



What's in the Nucleus?

- In the nucleus we find:
  - **Protons**: positively charged subatomic particles
    - Mass of 1 amu (1.67×10^{-24}g)
  - **Neutrons**: neutrally (0) charged subatomic particles
    - Mass of 1 amu (1.67×10^{-24}g)
    - These are larger and more massive than the electron.

What's in the Electron Cloud?

- In the electron cloud we find:
  - **Electrons**: the subatomic particle with a negative charge and *relatively* no mass
    - Mass of ~ 1/1836 amu

Quick Check

- Which part of the atom has a negative electrical charge?
- Electron
- Which part of the atom has a positive charge? No charge?
- Proton; Neutron

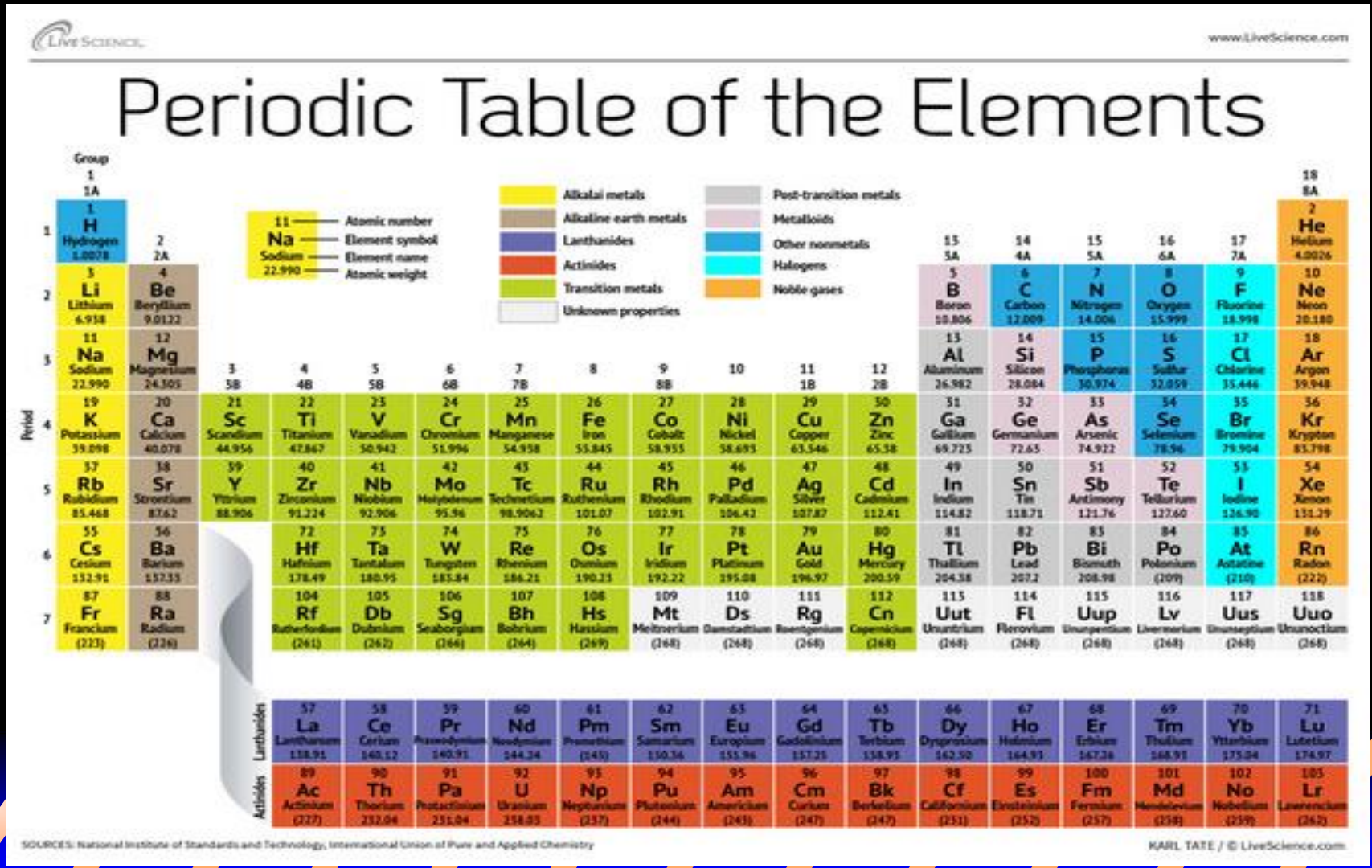
Subatomic Particles

Particle	Charge	Mass (g)	Location
Electron (e^-)	-1	9.11×10^{-28} We'll just say none	Electron cloud
Proton (p^+)	+1	1.67×10^{-24}	Nucleus
Neutron (n^o)	0	1.67×10^{-24}	Nucleus

What is an element?

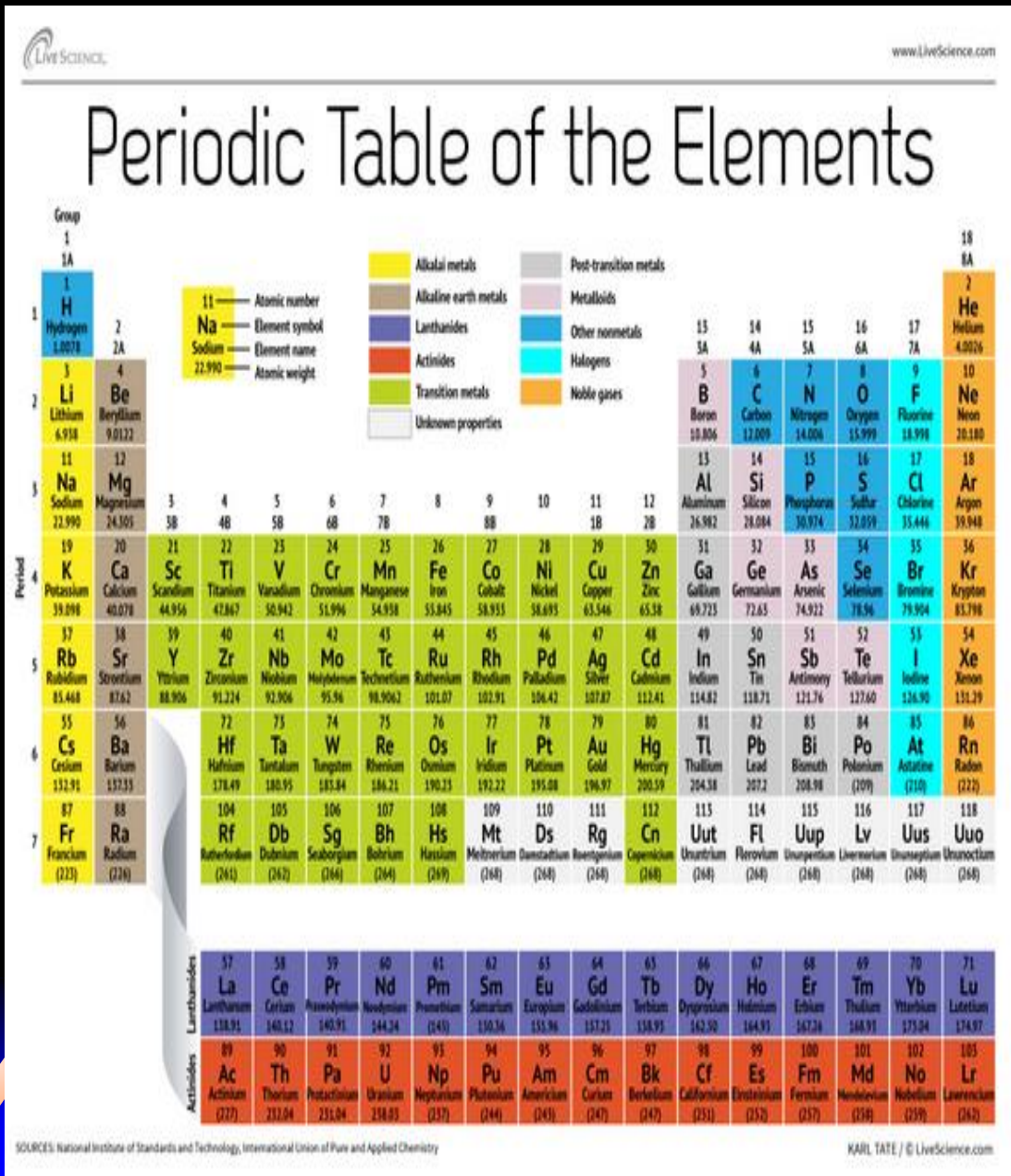
- Matter made of only one kind of atom.
- In other words, groups or collections of the same atom.
- At least 110 of these elements are known and at least 90 of them occur naturally on Earth.

A way to chart the elements



Quick look at the periodic table

- Elements are listed in squares. It's abbreviated (i.e. latin name, scientist, region, or first letter of element.
- Look at Helium (He).
- As all elements are made of the same particles (n,p,e) how can there be over 100? Let's take a look!!



The number of protons determine the identity of an element!

- How do we know the number of protons in an atom?
- Atomic number (#)= # of protons in an atom (the number at the top)
  - Ex: Hydrogen's atomic # is 1
    - hydrogen has 1 proton
  - Ex: Carbon's atomic # is 6
    - carbon has 6 protons

**The number of protons identifies the atom-it's an atom's fingerprint.

How do we know the number of neutrons in an atom?

- **Atomic Mass #** (the number on the bottom): the # of protons plus neutrons in the nucleus.
- How do we find the number of neutrons?
- # of neutrons = mass # - atomic #

  Example
  - Li has a **mass #** of 7 and an **atomic #** of 3
    - Protons = 3 (same as atomic #)
    - Neutrons= 7-3 = 4 (mass # - atomic #)

How do we find the number of electrons in an atom?

- Most atoms are neutral (have no overall charge)
- Because the only charged subatomic particles are the protons and electrons… they must balance each other out in an electrically neutral atom.
- Therefore..
  - # Electrons = # Protons *

* (in a neutral atom..)

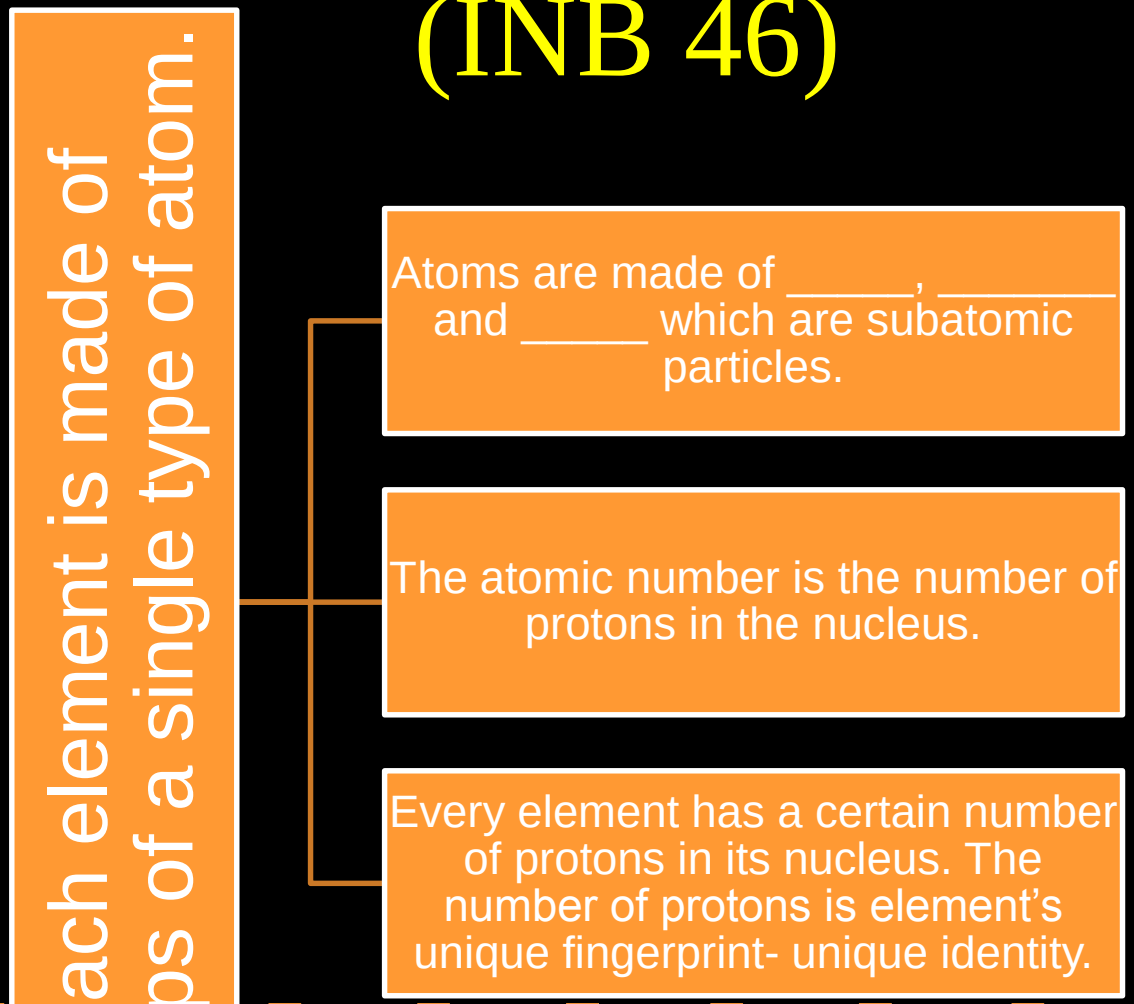
Examples

- He (Helium) has a mass # of 4 and an atomic # of 2
  - $p^+ = 2$ $n^o = 2$ $e^- = 2$
- Cl (Chlorine) has a mass # of 35 and an atomic # of 17
  - $p^+ = 17$, $n^o = 18$, $e^- = 17$

Quick check!

- How is atomic mass number different from atomic number?
- Atomic mass number includes the protons and neutrons in the nucleus. Atomic number is the number of protons in the nucleus.

Atoms: Independent Practice (INB 46)

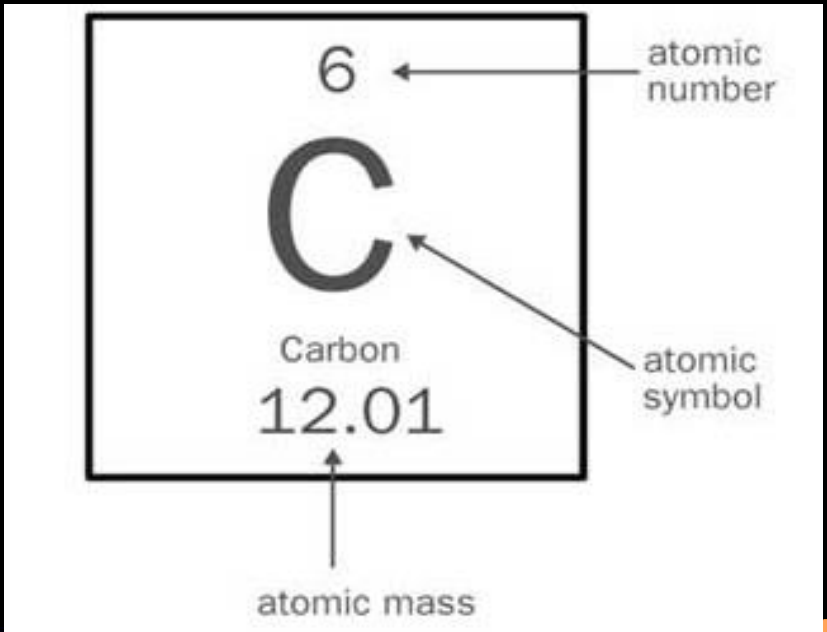


Nucleus

- Central part of the atom
- Contains most of atom's _____ (extremely dense)
- _____ move rapidly around it
- Made of protons and _____
- It is positively charged as it contains a proton (+ charge) and a neutron (0 charge).

On the bottom of page 46

- Write what the atomic # is and the atomic mass # is after drawing this.



- Using your textbook, turn to page 78 and draw the model of an atom.

Homework: Review Notes and complete drawing

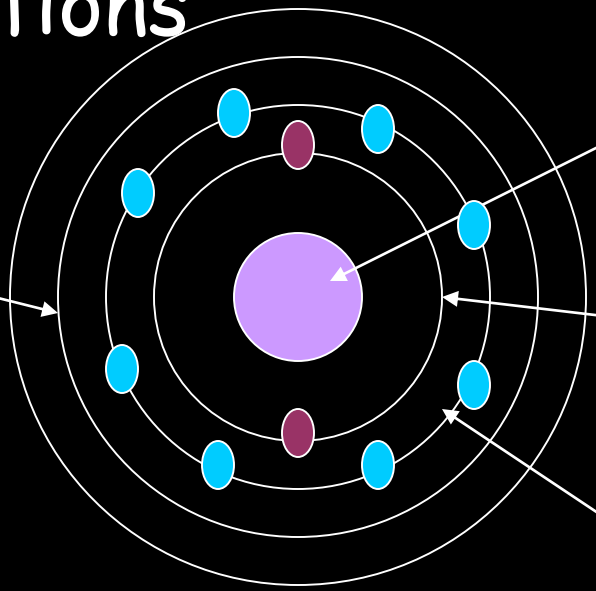
Ticket out the door

- How are atoms and elements related?
- What are elementary particles/subatomic particles?

Homework: Review Notes and complete drawing

How exactly are the particles arranged?

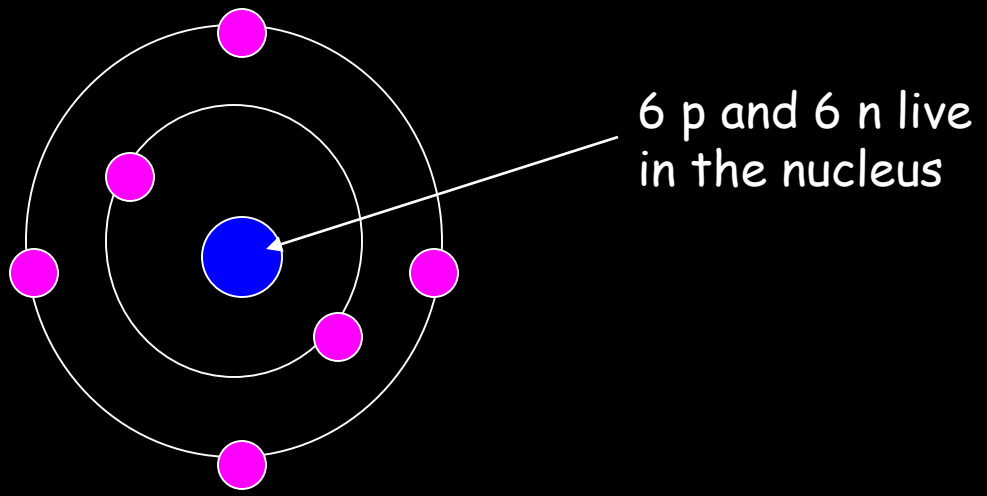
- Bohr Model of the atom: electron configurations



What does carbon look like?

Mass # = 12

atomic # = 6



$p^+ = 6$

$n^o = 6$

$e^- = 6$

Build an atom

- https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html

Warm up 10/19/15 (Write the definitions and question)

- 1. An element is a substance that can't be separated into simpler substances by physical or chemical means. A pure substance is a substance in which there's only one type of particle (atom).
- By using this definition, is an element a pure substance?
- Yes, because an element contains only one type of particle (atom). Ex. Piece of iron is made up of billions of iron atoms (particles)

Agenda

- Atomic Model Video
- Periodic Table Video
- Periodic Table Notes/Diagram
- Periodic Table- Element uses (BP)
- Homework: Practice learning the groups (families) and the characteristics of each. Review chemical symbols in the back of textbook. (WRITE THIS DOWN)

Test this Friday! Study Guide will be given on Thursday

- Test this Friday on:

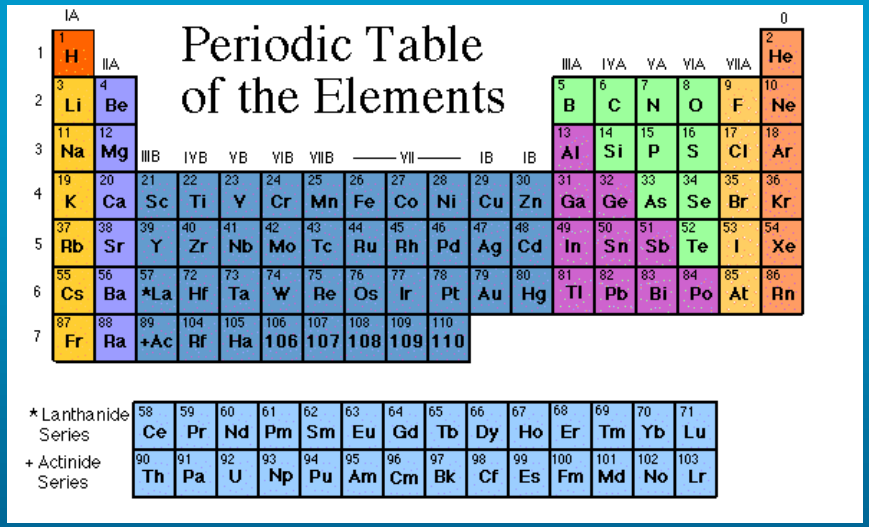
Atoms and it's subatomic particles (neutrons, protons, and electrons)

Periodic Table (families vs periods, 3 categories of elements)

Electron Configurations (valence electrons).

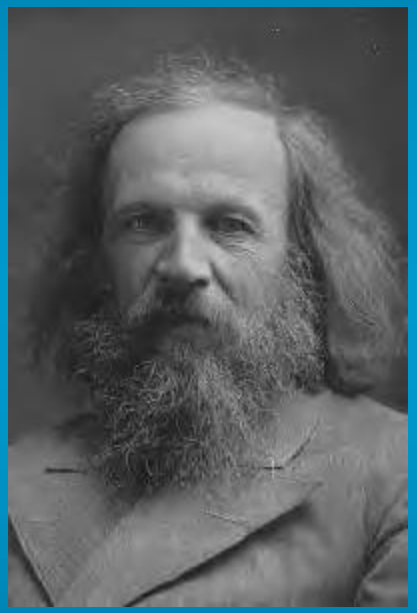
Ions, Compounds, Molecules, and elements

Periodic Table of Elements



Mendeleev

- In 1869, Dmitri Ivanovitch Mendeléev created the first accepted version of the periodic table.
- He grouped elements according to their atomic mass, and as he did, he found that the families had similar chemical properties.
- Blank spaces were left open to add the new elements he predicted would occur.



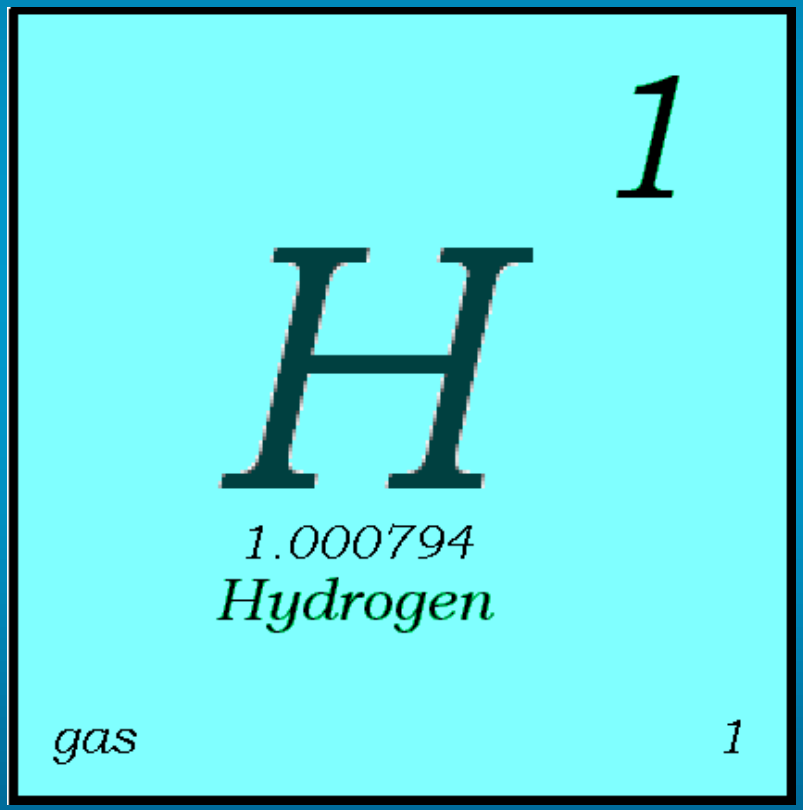
Periodic Table of the Elements

1 IA	2 IIA	3	4	5	6	7	8	9	10	11	12	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.9)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac~ (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Uuu (272)	112 Uub (277)	113 Uut	114 Uuq	115 Uup	116 Uuh		

*Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
~Actinides	90 Th 232.0	91 Pa (231)	92 U (238)	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

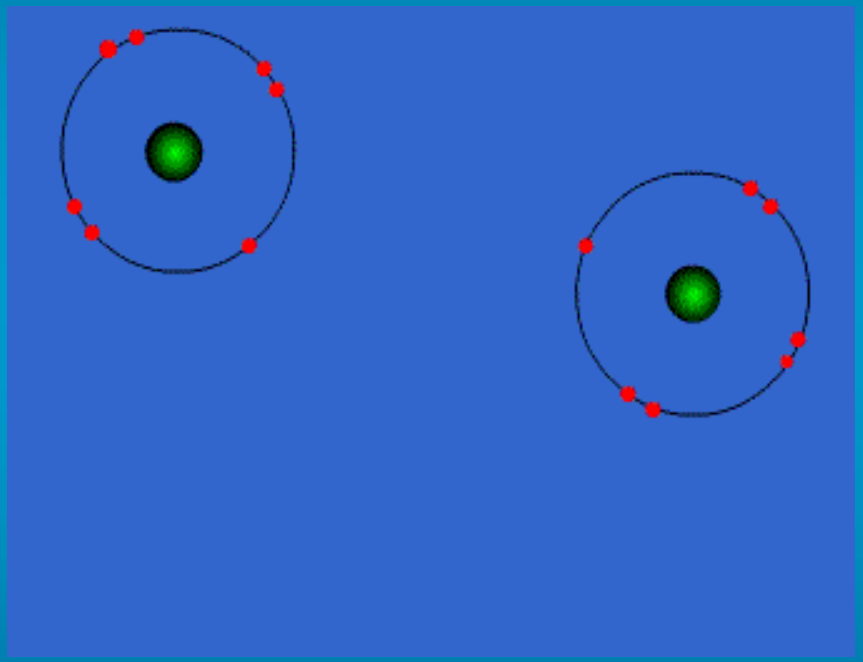
What's in a square?

- Different periodic tables can include various bits of information, but usually:
  - atomic number
  - symbol
  - atomic mass
  - number of valence electrons
  - state of matter at room temperature.

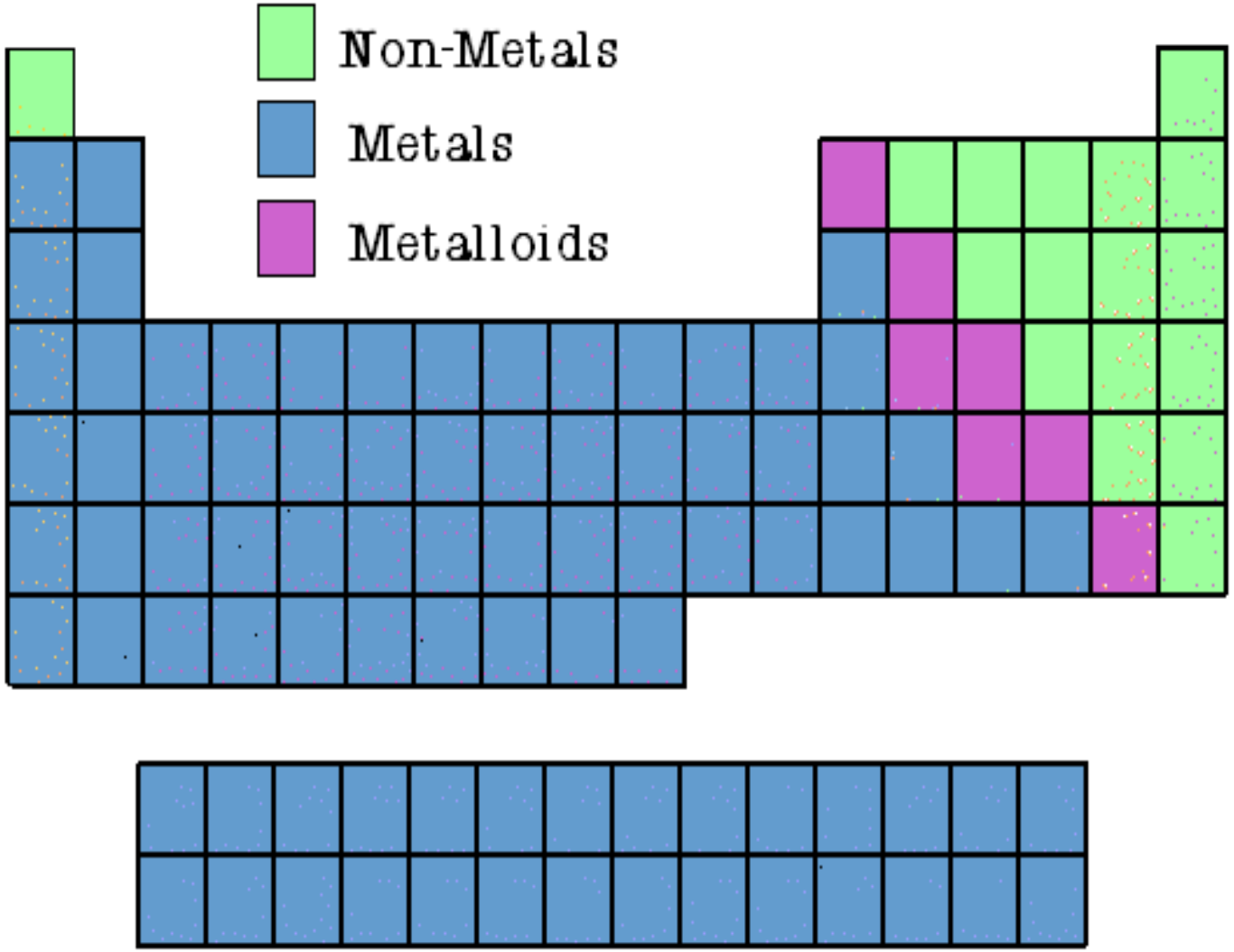


Valence Electrons

- The number of **valence electrons** an atom has may also appear in a square.
- Valence electrons are the electrons in the outer energy level of an atom.
- These are the electrons that are transferred or shared when atoms bond together. (Chemical bonds)
- WE'LL DISCUSS THIS MORE SOON! ☺



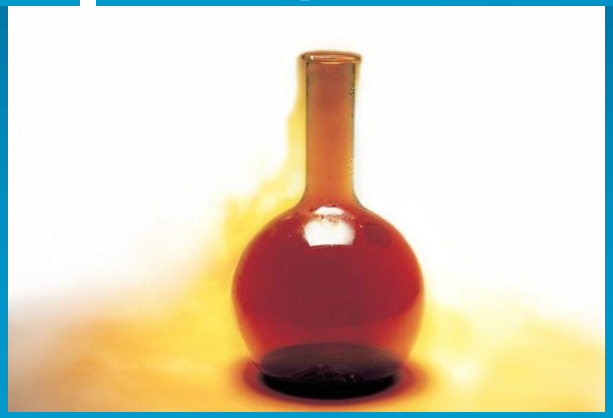
The elements of the periodic table can be divided into three main categories: Metals, Non-Metals, and Metalloids.



Properties of Metals

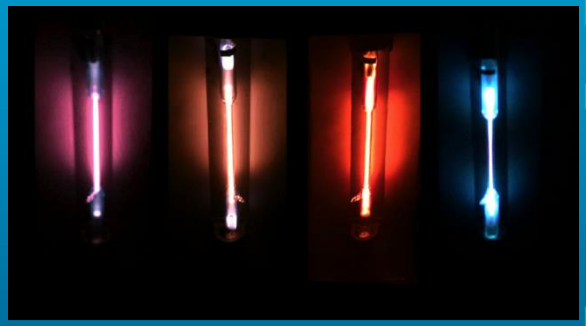
- Metals are good conductors of heat and electricity.
- Metals are shiny.
- Metals are ductile (can be stretched into thin wires).
- Metals are malleable (can be pounded or bent into thin sheets).
- A chemical property of metal is its reaction with water which results in corrosion.
- Gold, Copper, iron, silver, lead, etc

Properties of Non-Metals



Bromine (Br)

Sulfur



Variety of heated gases

- Non-metals are poor conductors of heat and electricity.
- Non-metals are not ductile or malleable.
- Solid non-metals are brittle and break easily.
- They are dull.
- Many non-metals are gases. (Located on right)
- Oxygen, Chlorine, Nitrogen, Carbon, Bromine, Neon, etc

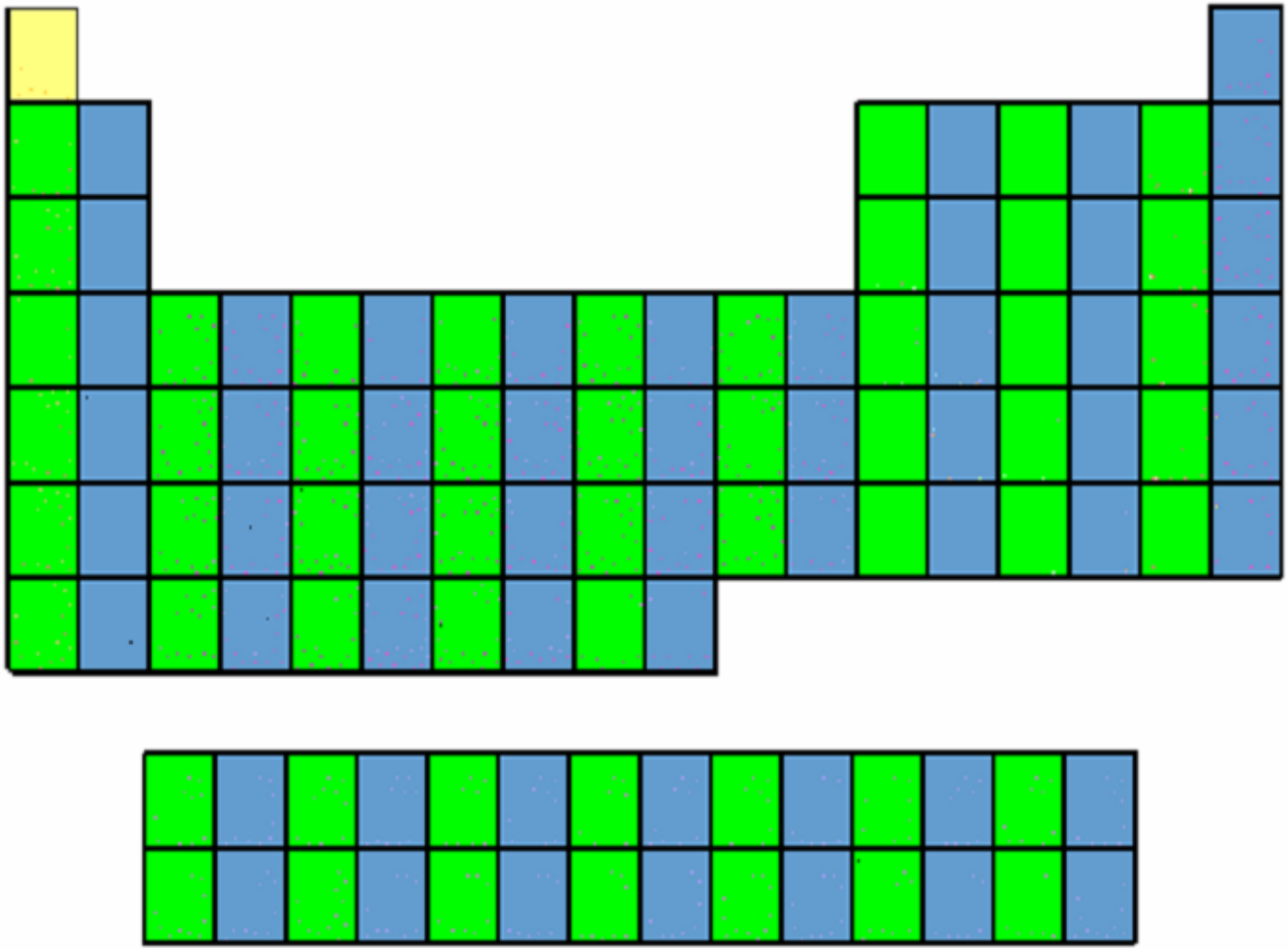
Properties of Metalloids

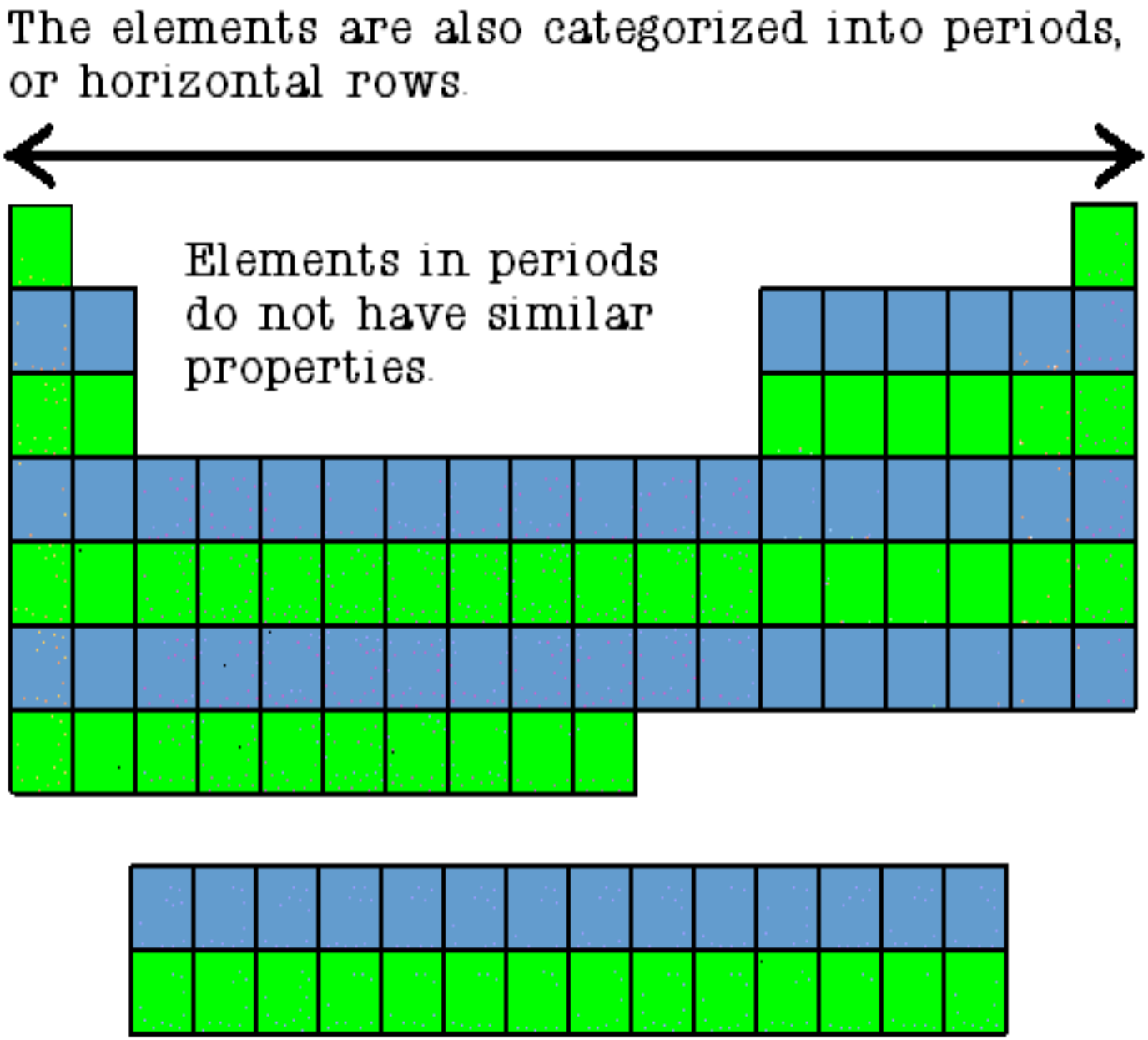
Silicon

Antimony

- Metalloids (metal-like) have properties of both metals and non-metals.
- They are solids that can be shiny or dull.
- They conduct heat and electricity better than non-metals but not as well as metals.
- They are ductile and malleable.
- Ex. Silicon which can be used in electronic circuits in computers and TV.

Elements in the periodic table are also grouped into families, which are the columns. Elements in families have similar properties.





They all have the same # of electron shells (shells a.k.a are the paths electrons take as they travel

Families

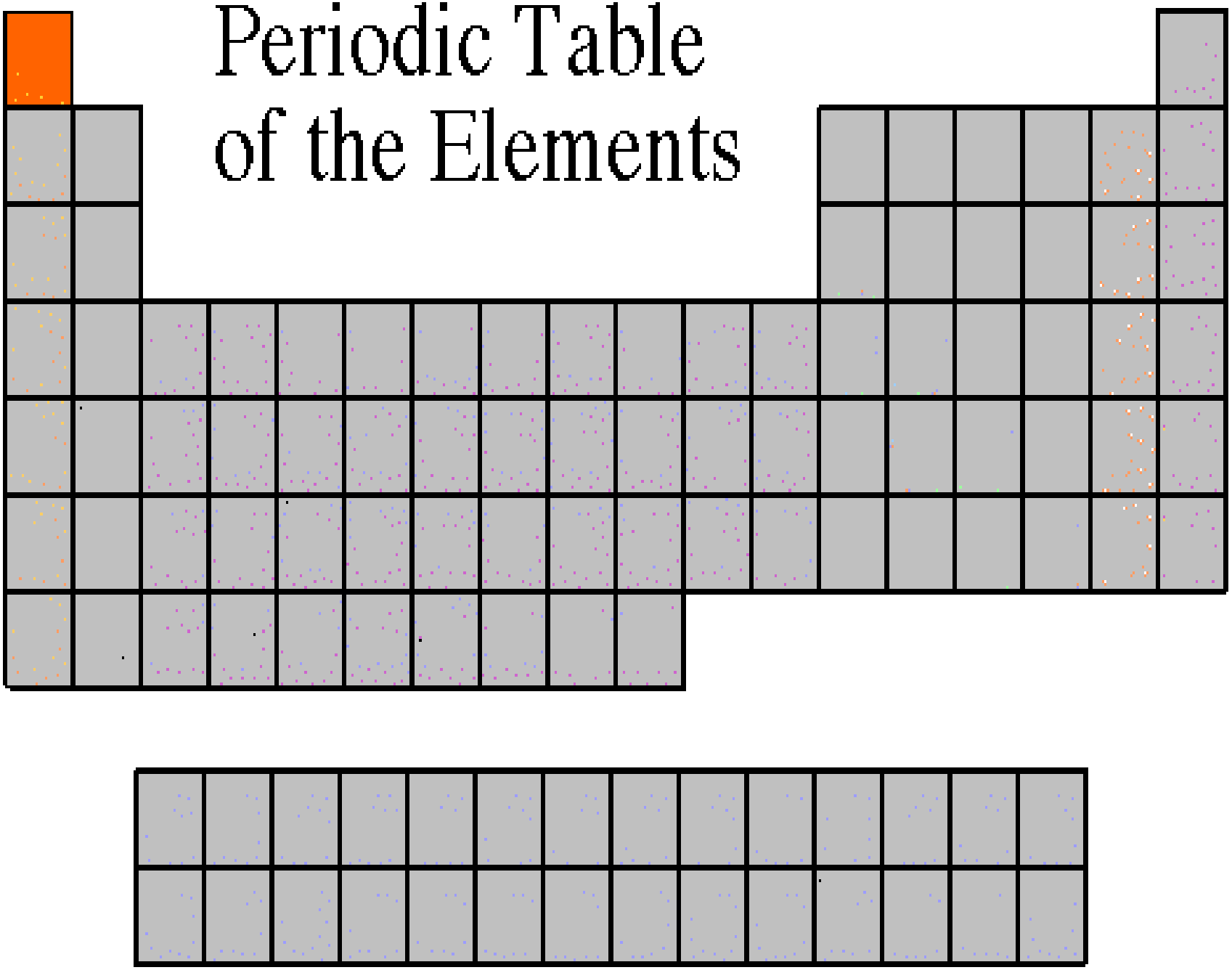
- Columns of elements are called groups or families.
- Elements in each family have similar but not identical properties.
- For example, lithium (Li), sodium (Na), potassium (K), and other members of family group 1 are all soft, white, shiny metals.
- All elements in a family have the same number of valence electrons. (NUMBER OF ELECTRONS IN OUTER shell)
- They are the electrons involved in chemical bonds with other elements.

Periods

- Each horizontal row of elements is called a period.
- The elements in a period are not alike in properties, but have the same # of electron shells.
- In fact, the properties change greatly across a given row.
- The first element in a period is always an extremely active solid. The last element in a period, is always an inactive gas.

Families

Periodic Table of the Elements



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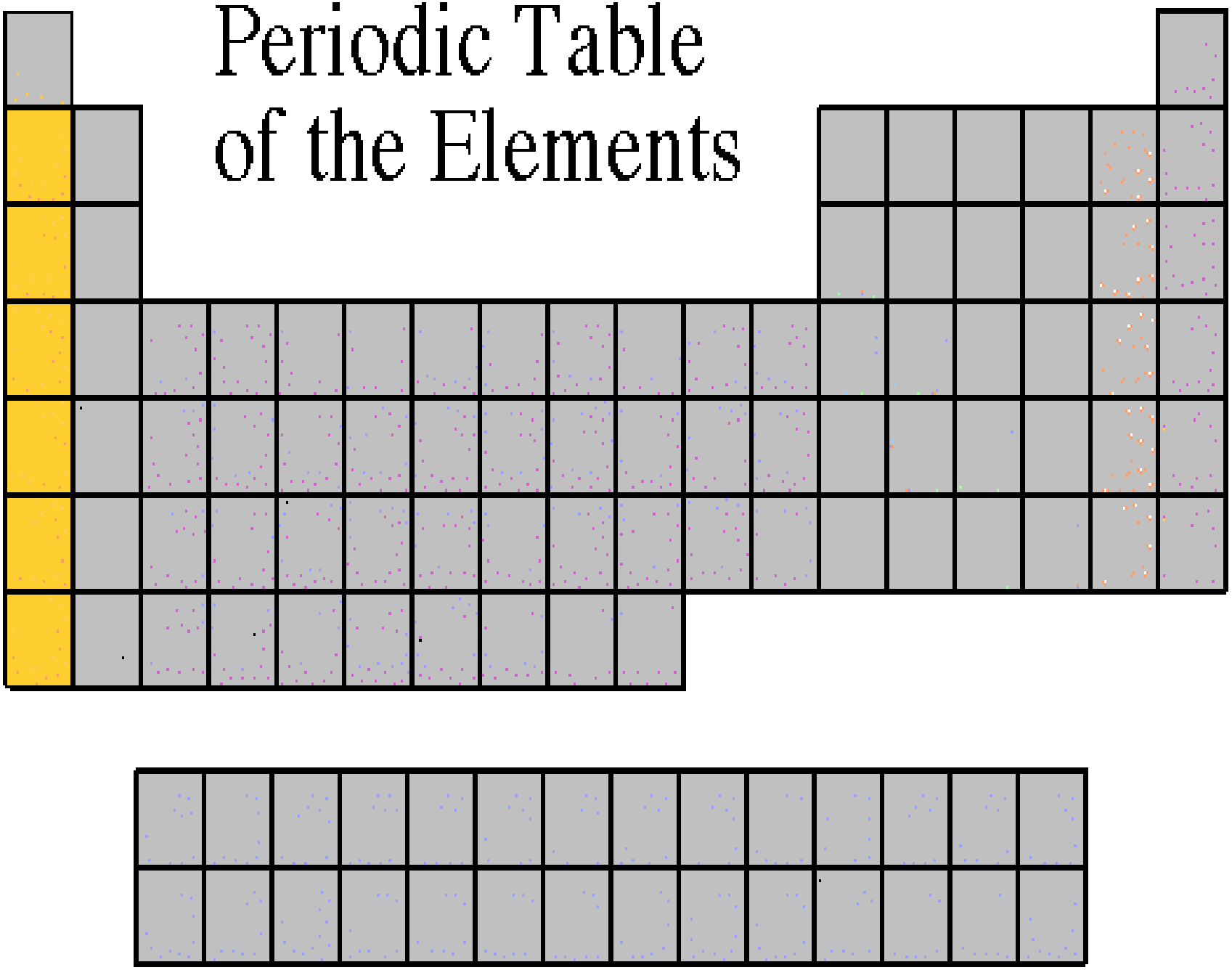

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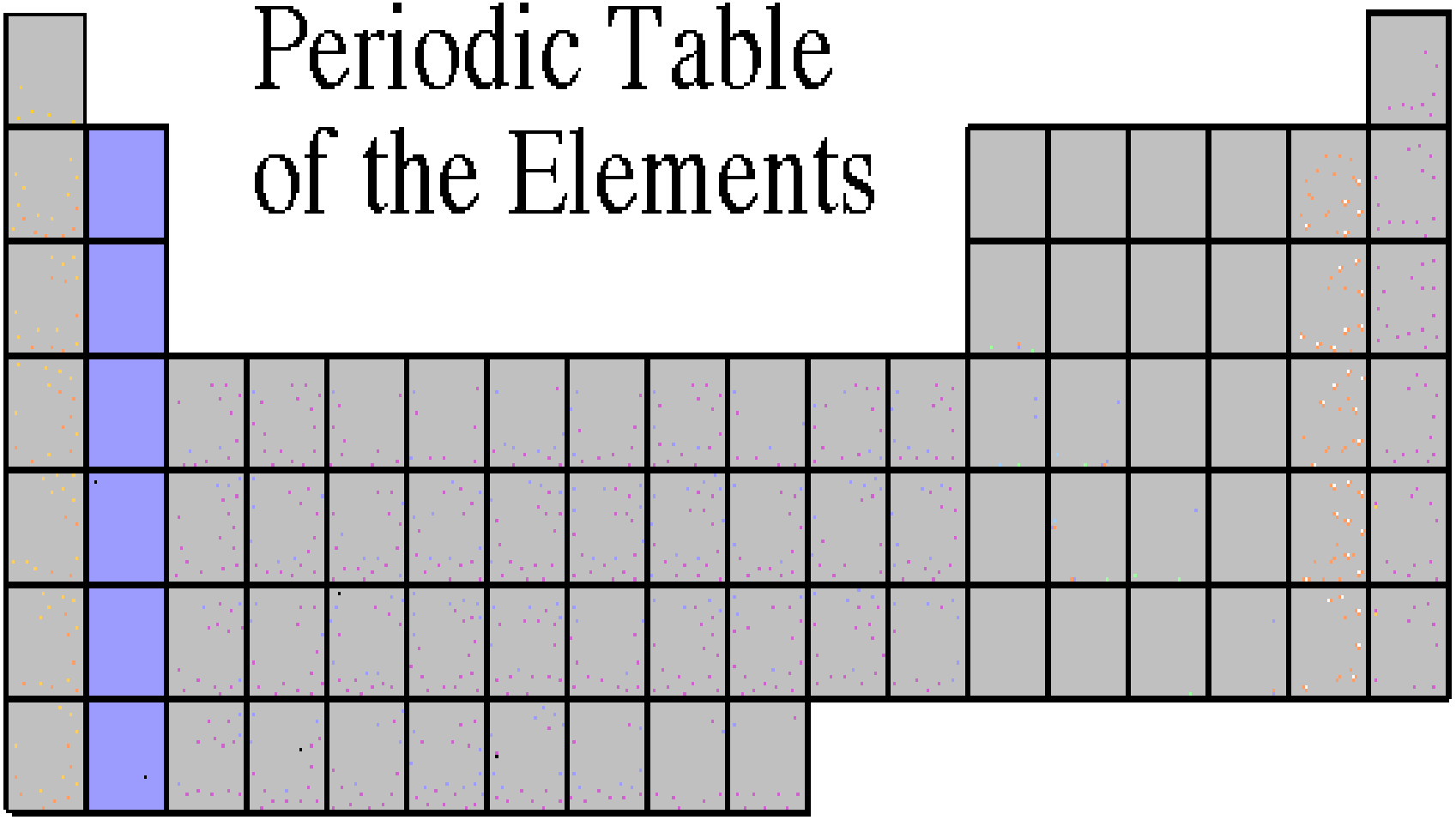

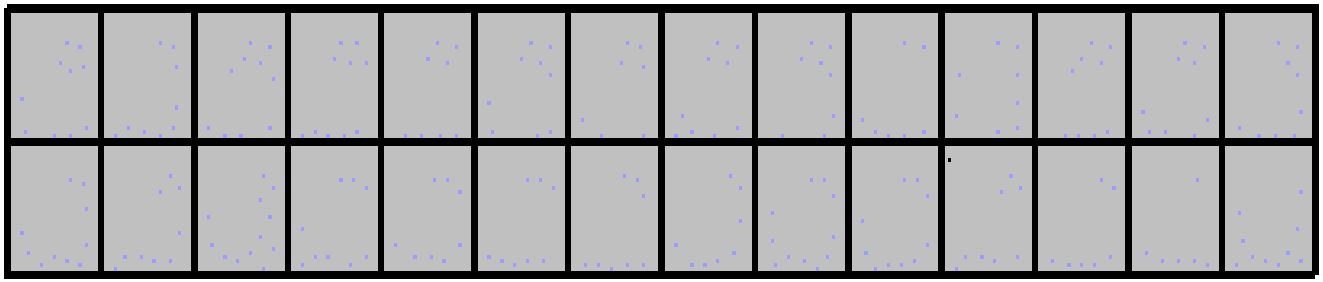

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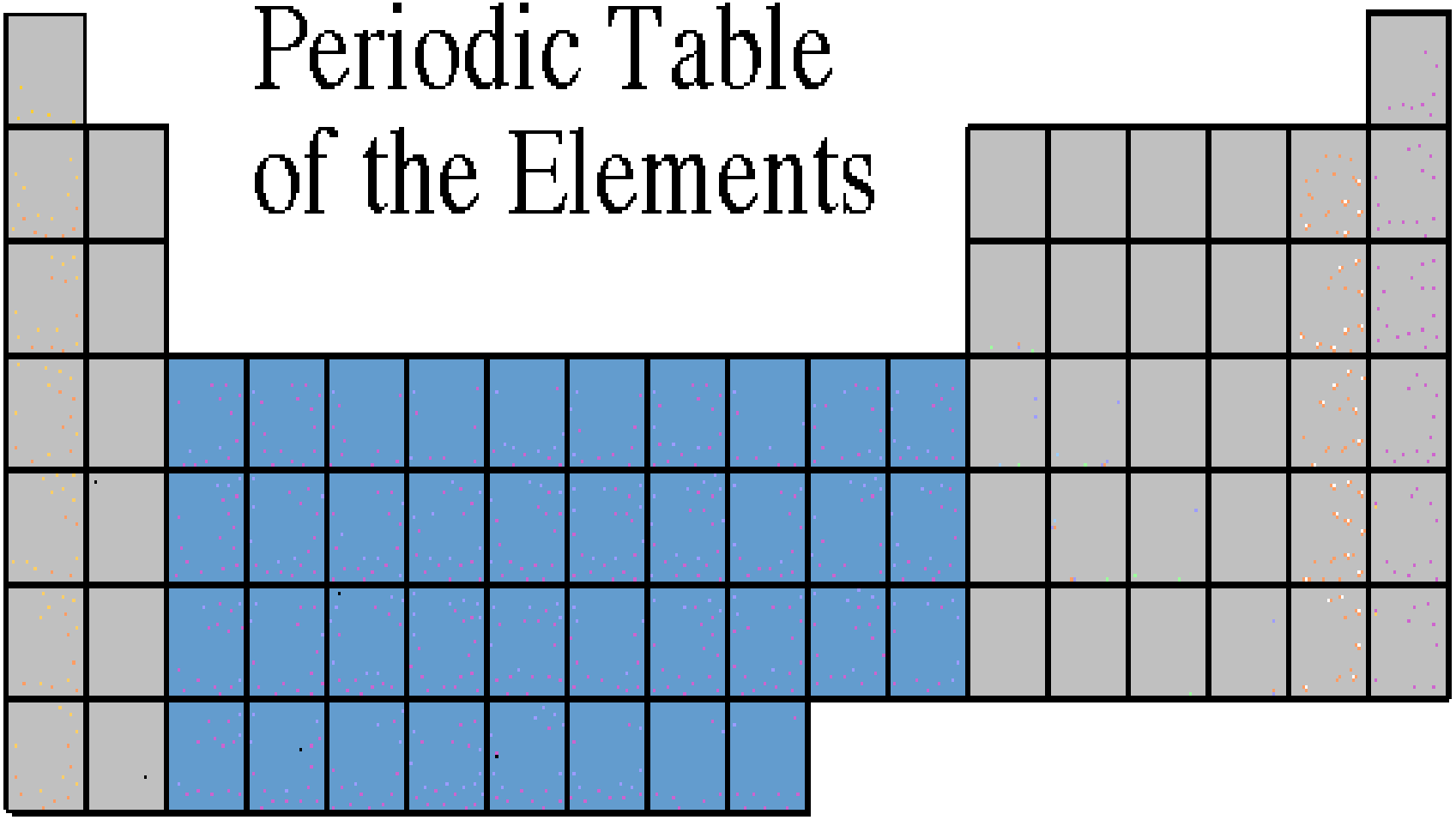

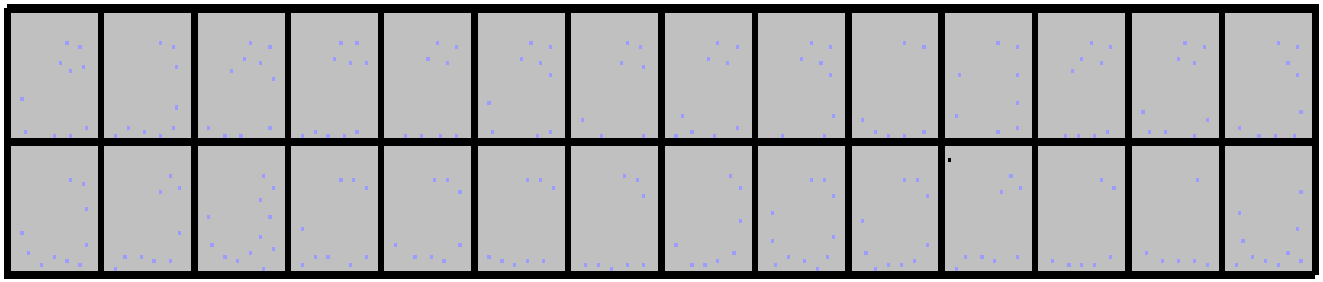

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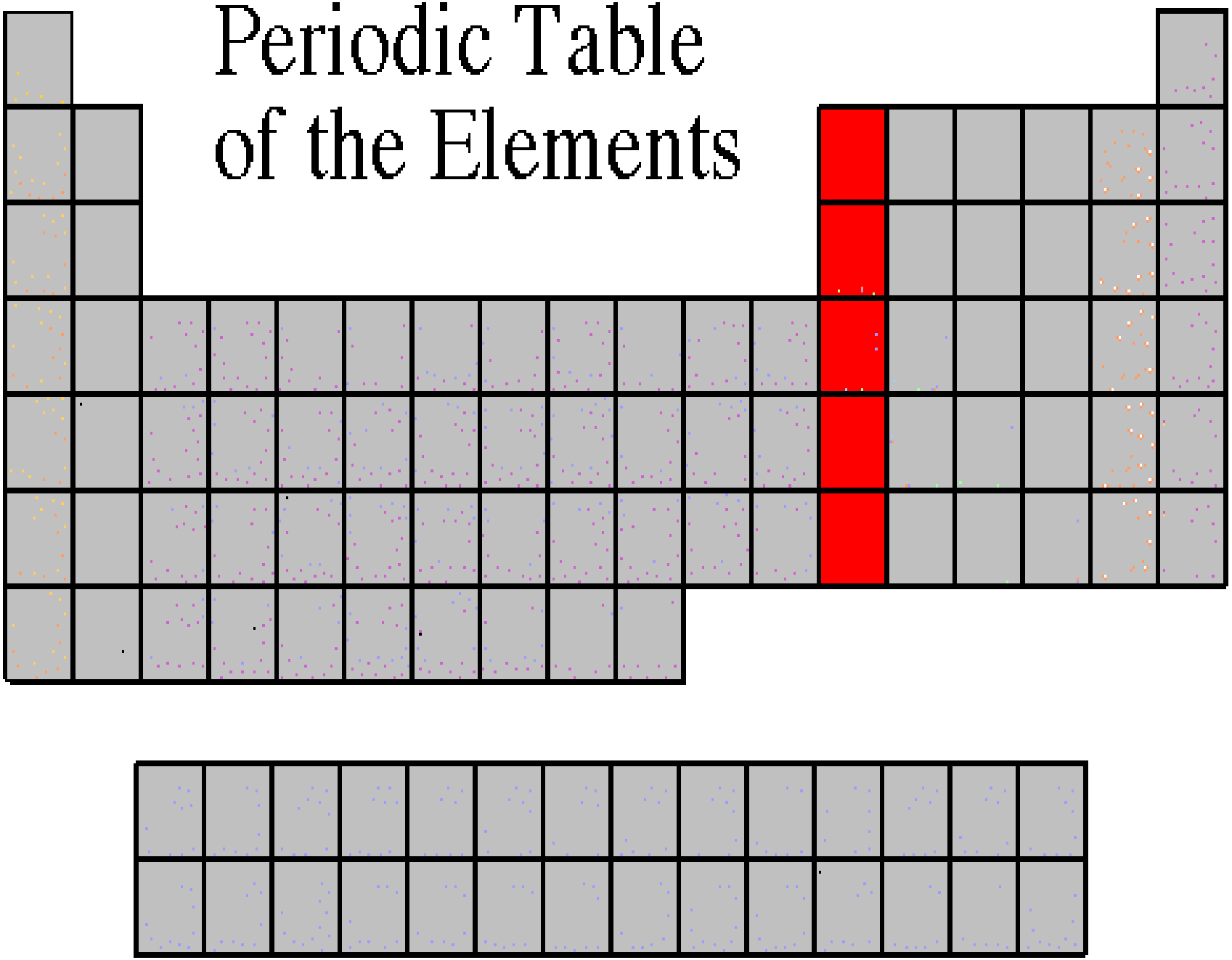

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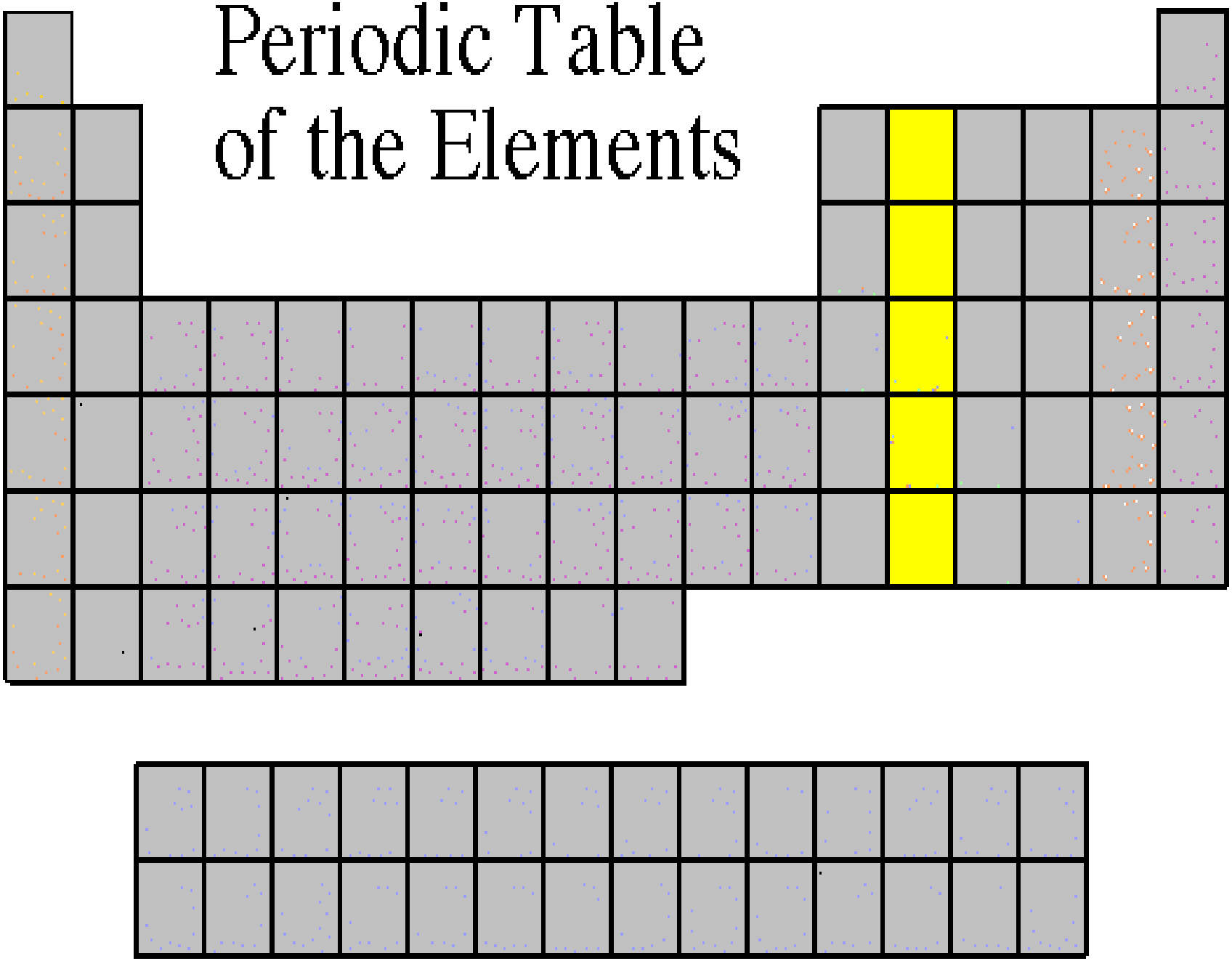

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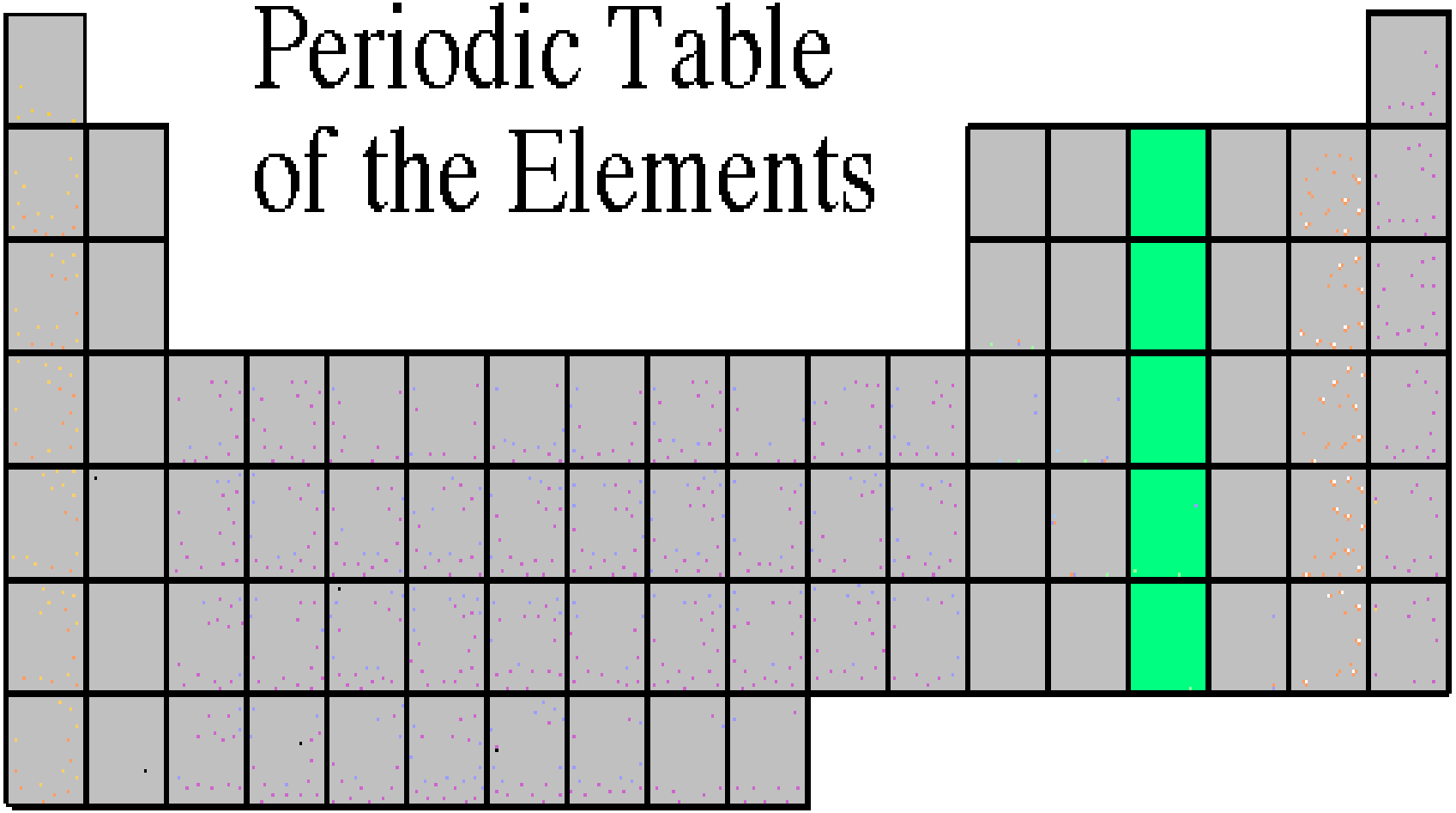

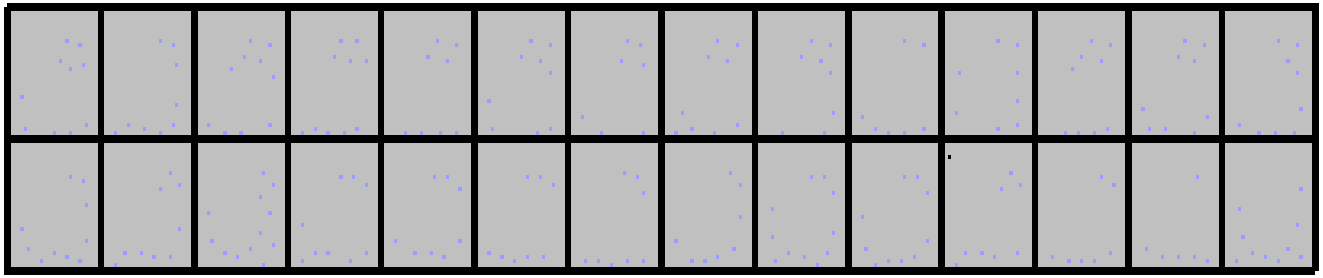

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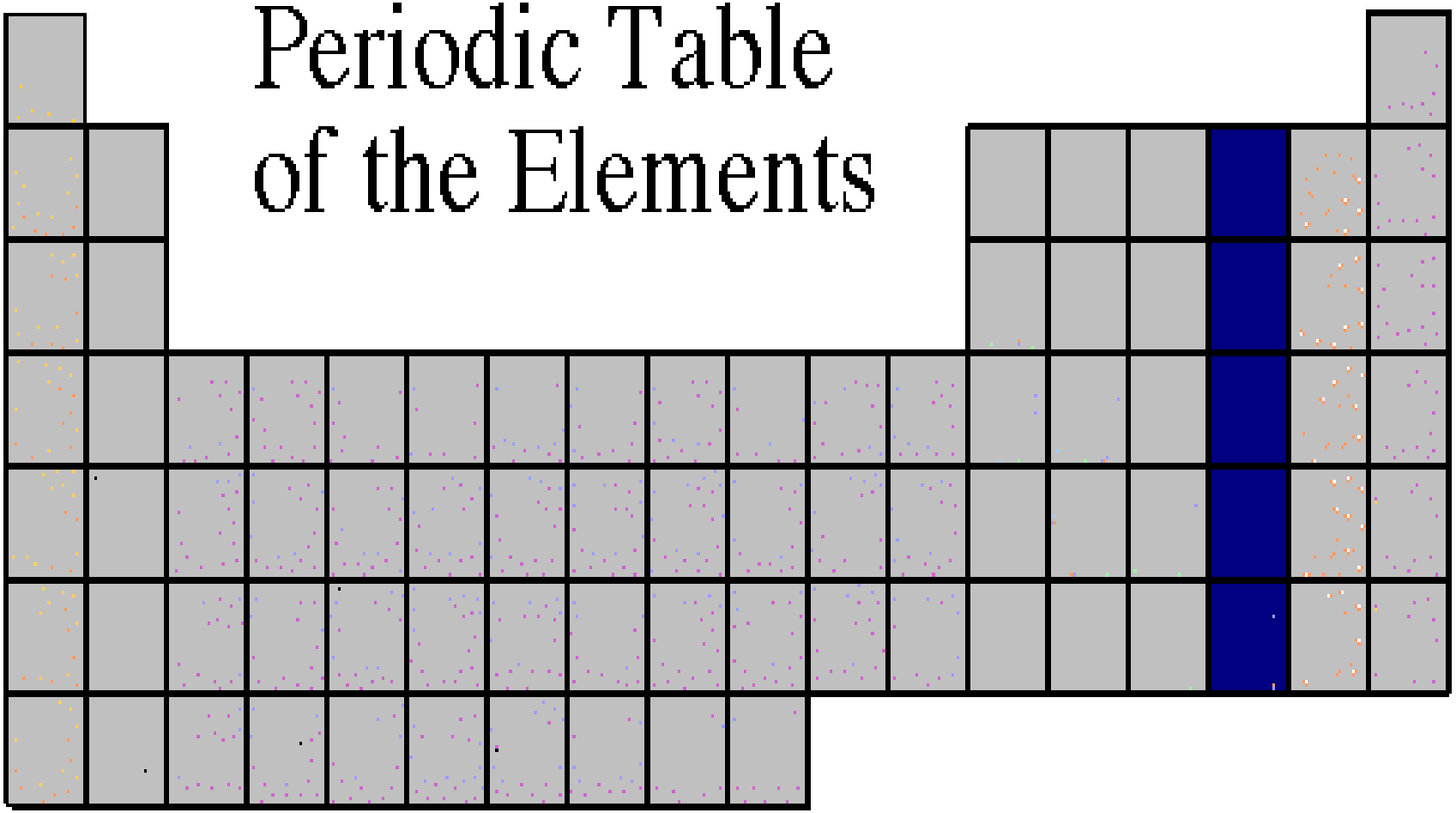

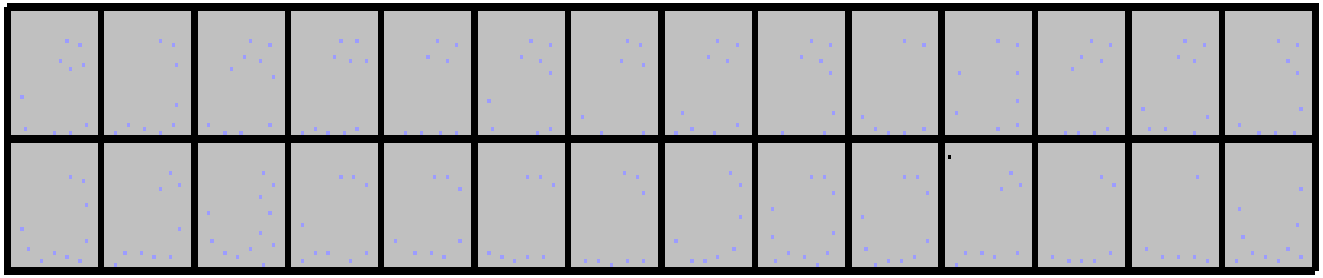

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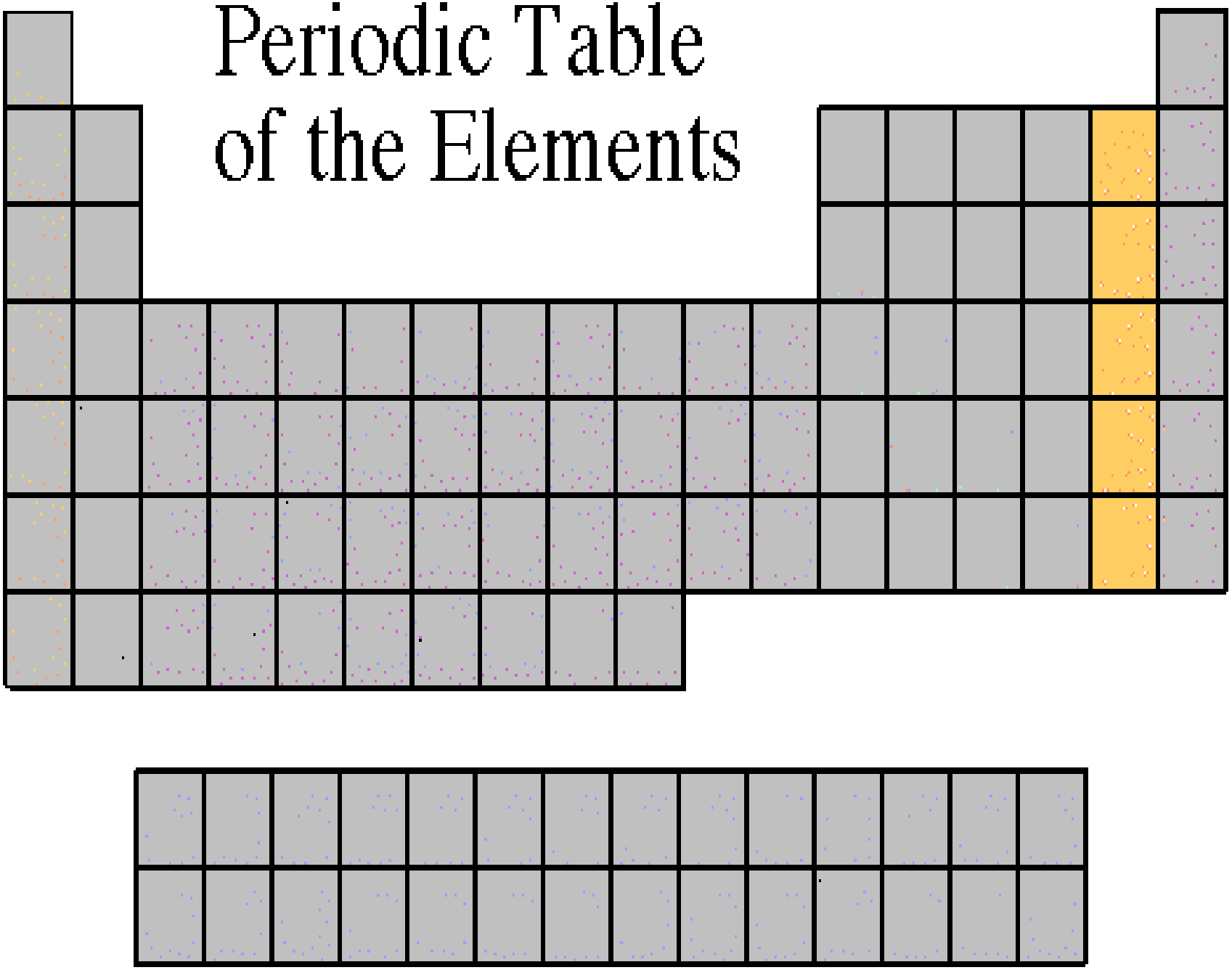

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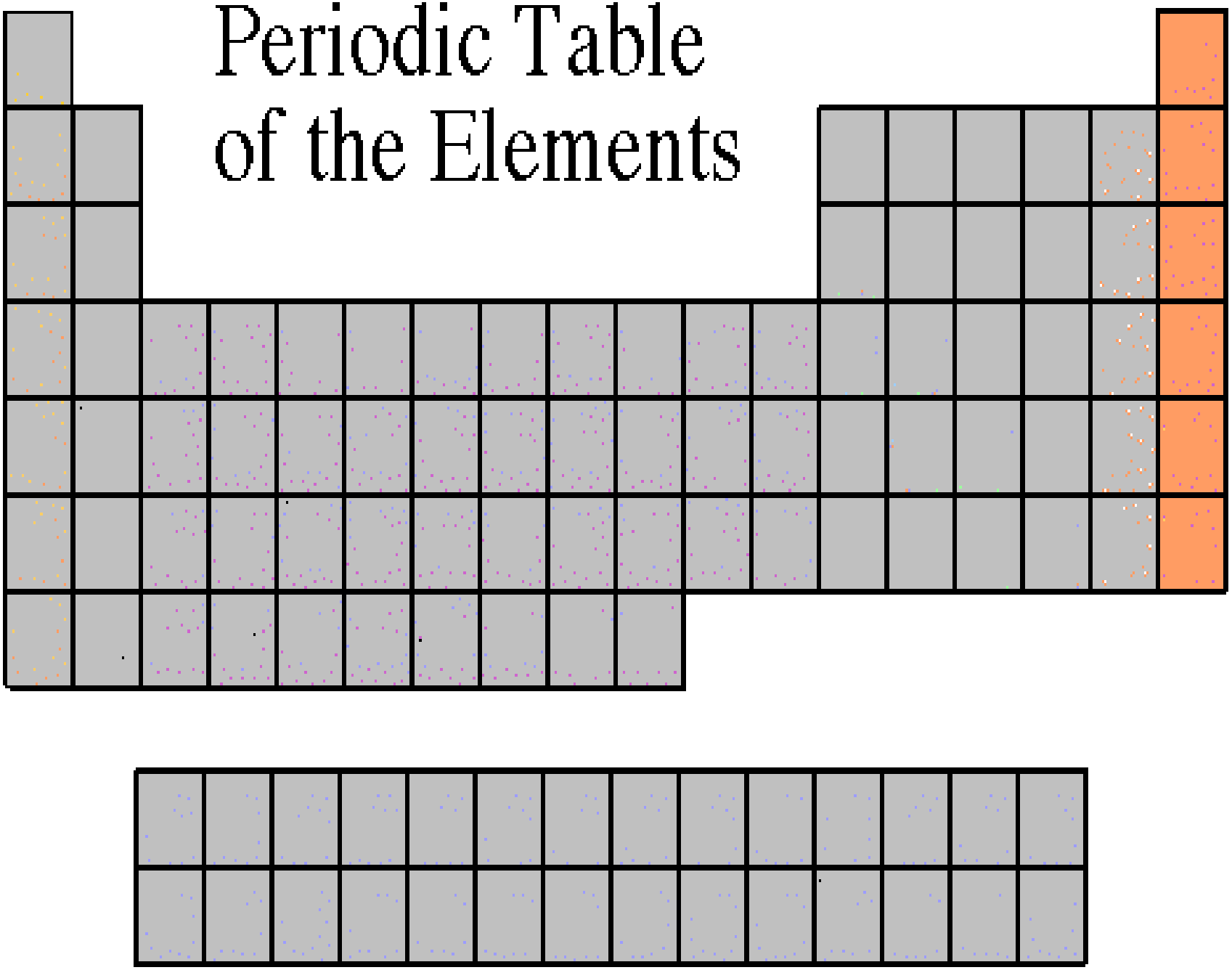

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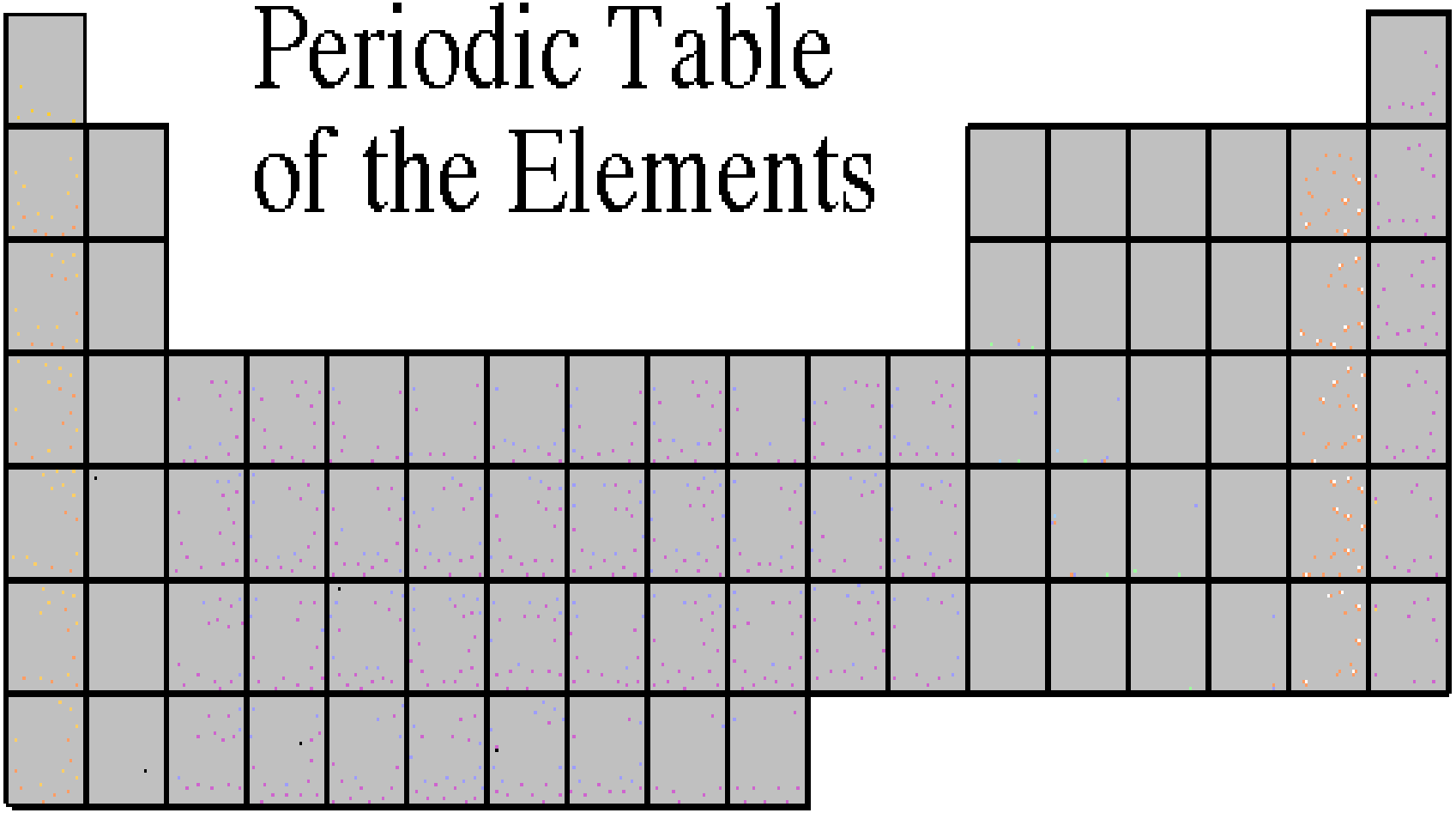
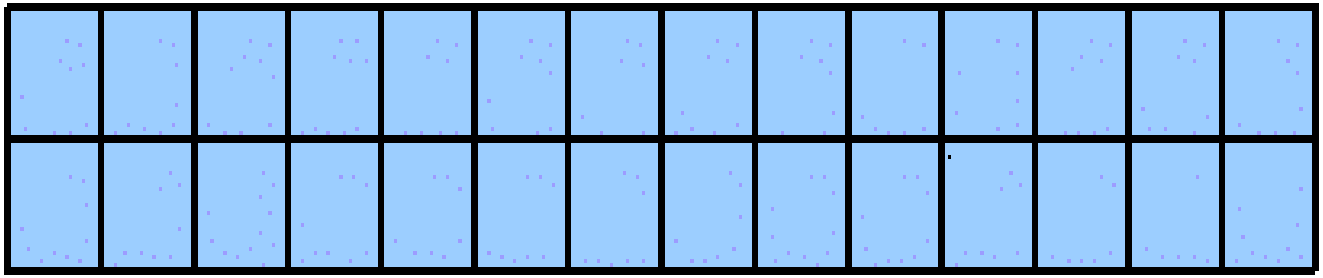
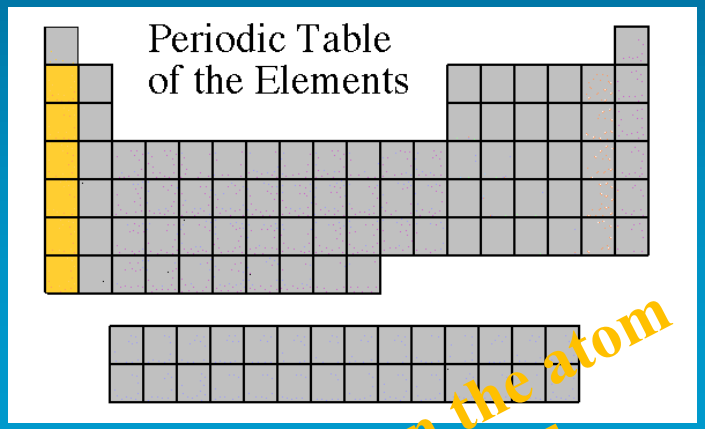




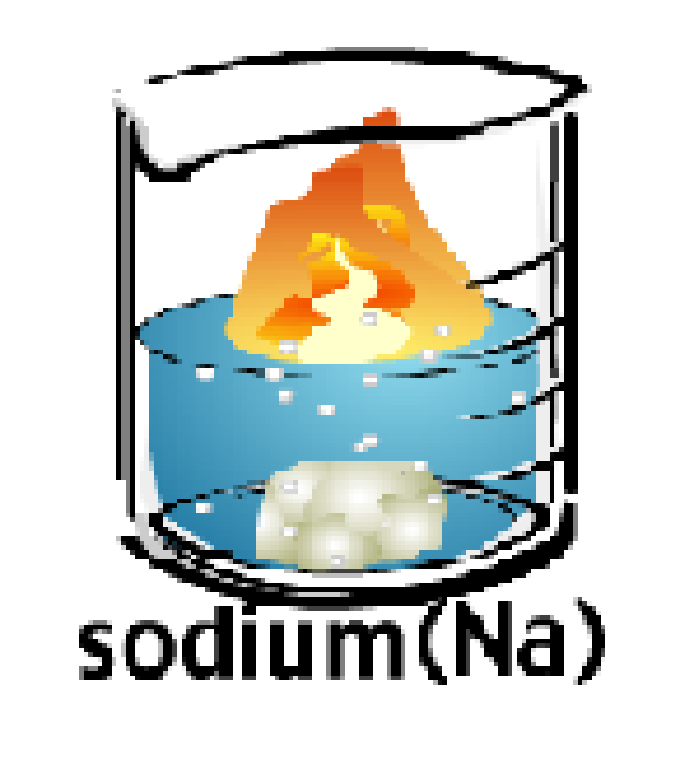
Alkali Metals – Group 1

- The alkali family is found in the first column of the periodic table.
- All are metals and solid at room temp.
- Only one is a gas (Hydrogen)
- 1 valence electron in outermost shell
- Very reactive, especially with water.
- Soft, silvery and shiny.
- Conductors of electricity.



Something is reactive when the atom has an increased desire to bond means you are more reactive

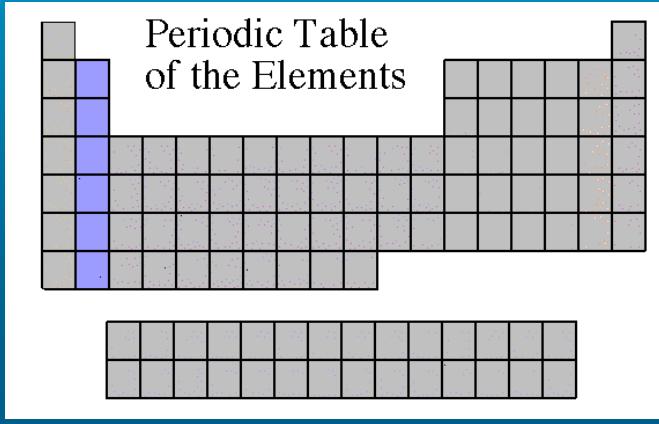
Alkali Metals



- They are the most reactive metals.
- They react violently with water.
- Alkali metals are never found as free elements in nature. They are always bonded with another element.

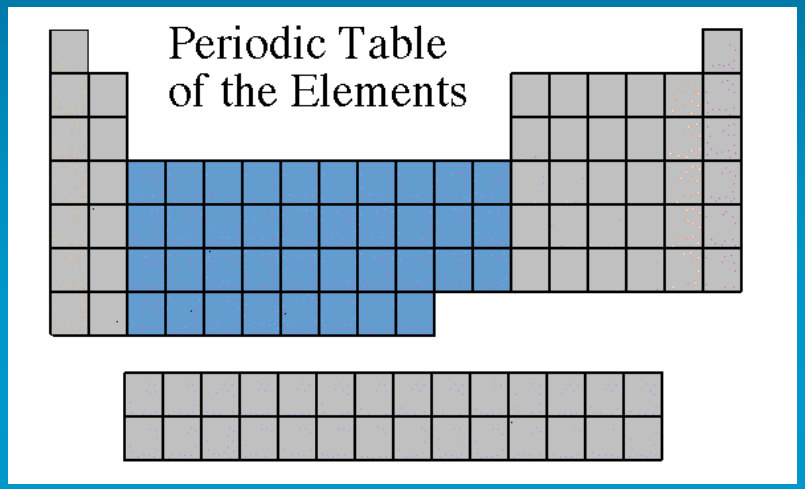
Alkaline Earth Metals- Group 2

- They are never found uncombined in nature.
- They have two valence electrons.
- Alkaline earth metals include magnesium and calcium, among others. (Solid metal)
- White silvery and malleable.
- Reactive, but less than Alkali
- Conductors of electricity



Transition Metals

- These are the metals you are probably most familiar: copper, tin, zinc, iron, nickel, gold, and silver.
- Transition Elements are mostly metal (solid) except for Mercury-liquid metal.
- 1 or 2 valence electrons
- Less reactive than Alkali and Alkaline.
- They are good conductors of heat and electricity.
- They're unique as they have 2 unhappy electron shells that need to bond to another element

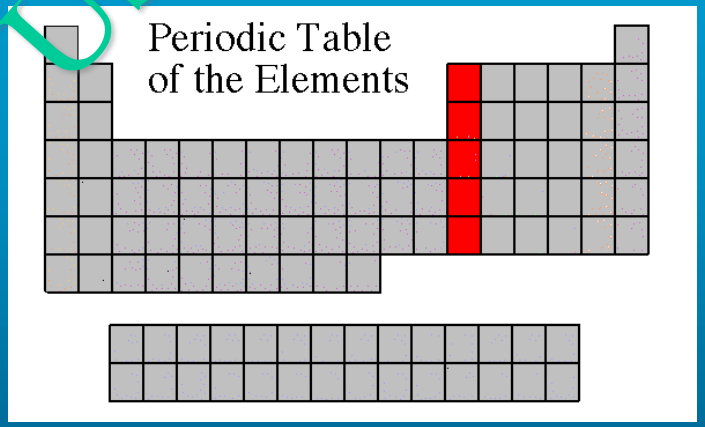


Transition Metals

- The compounds of transition metals are usually brightly colored and are often used to color paints.
- Transition elements have 1 or 2 valence electrons, which they lose when they form bonds with other atoms. Some transition elements can lose electrons in their next-to-outermost level.

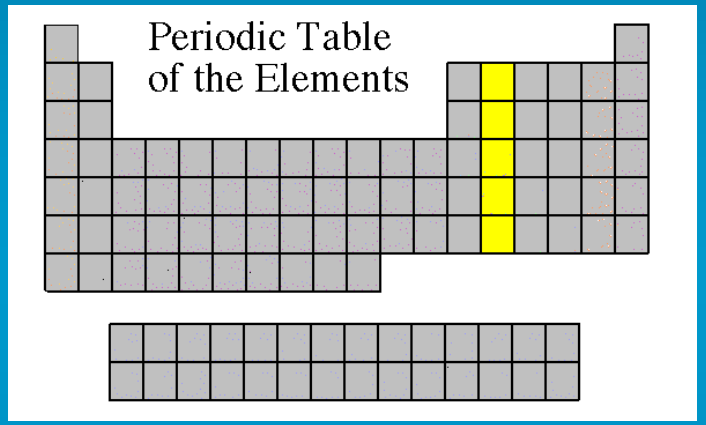
Boron Family- Group 3

- The Boron Family is named after the first element in the family.
- Atoms in this family have 3 valence electrons.
- This family includes a metalloid (boron), and the rest are metals.
- This family includes the most abundant metal in the earth's crust (aluminum).
- Solid at room temp. and reactive



Carbon Family- Group 4

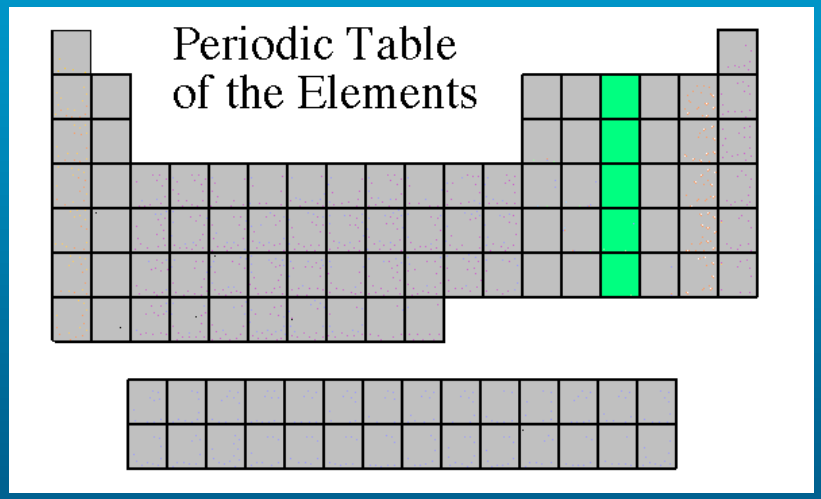
- Atoms of this family have 4 valence electrons.
- This family includes a non-metal (carbon), metalloids, and metals.
- Reactivity varies
- Solids at room temp.



Germanium has important semiconductor properties and is used in the computer industry. It is one of the few elements that expand when frozen. Lead has long been used for plumbing and is also used to block radiation. Tin was once used to make cans because it is relatively stable -- unreactive.

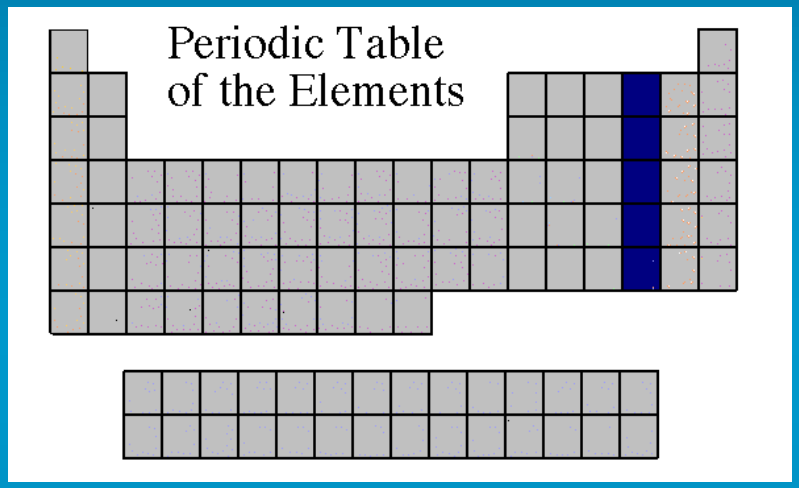
Nitrogen Family- Group 5

- 5 electrons in outermost shell
- Can share electrons to form compounds.
- Contains 2 metals, 2 metalloids, 2 non metals.
- Reactivity varies
- Nitrogen is the only gas at room temp. the rest are solids when they bond.
- Solid and gases make up this family



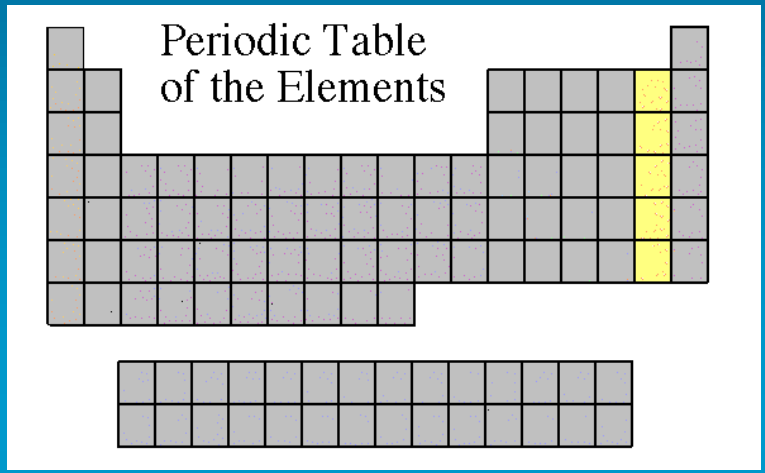
Oxygen Family- Group 6

- Atoms of this family have 6 valence electrons.
- Most elements in this family share electrons when forming compounds.
- Reactive (can bond with other elements).
- Oxygen is the only gas the rest are solids.



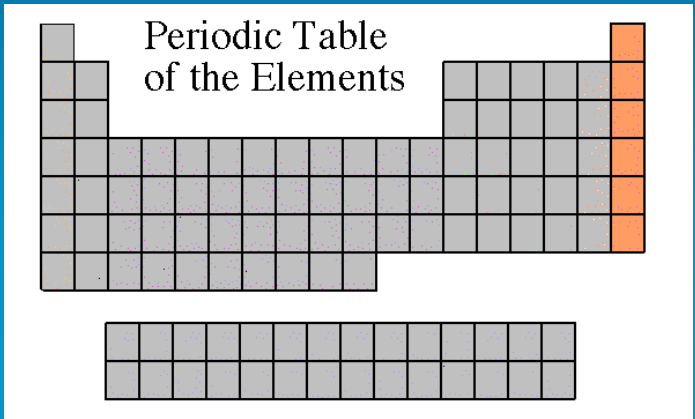
Halogen Family- Group 7

- The elements in this family are fluorine, chlorine, bromine, iodine, and astatine.
- Halogens have 7 valence electrons, which explains why they are the most active non-metals (VERY ACTIVE). They are never found free in nature.



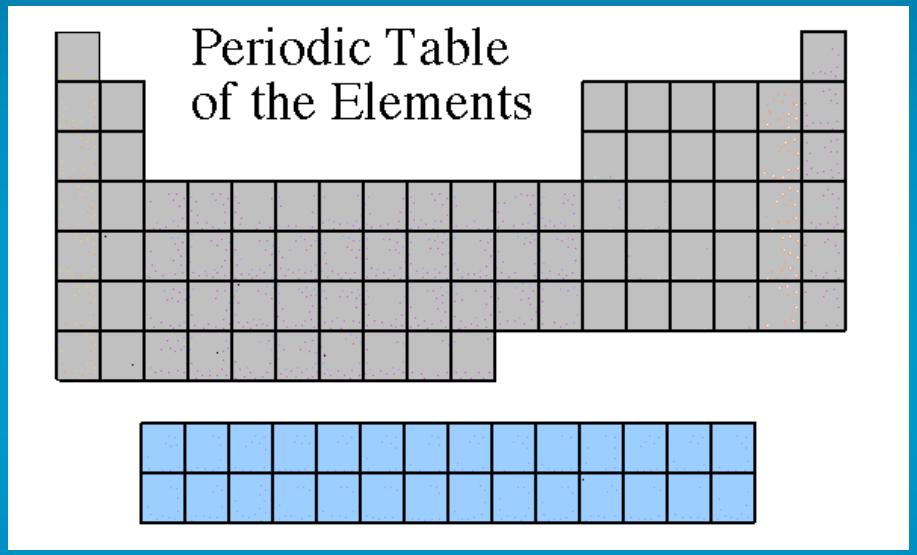
- Halogen atoms only need to gain 1 electron to fill their outermost energy level.
- They react with alkali metals to form salts.
- Has 2 gases, 1 liquid (Br) and 2 solids.

Noble Gases- G8



- Noble Gases are colorless gases that are extremely un-reactive.
- One important property of the noble gases is their inactivity. They are inactive because their outermost energy level is full. (Happy atom)
- 8 electrons in the outer most shell.
- Nonmetals
- The fact that their outer shells are full means they are quite happy and don't need to react with other elements. In fact, they rarely combine with other elements.

Rare Earth Elements



- The thirty rare earth elements are composed of the lanthanide and actinide series.
- One element of the lanthanide series and most of the elements in the actinide series are called trans-uranium, which means synthetic or man-made.
- Radioactive!

Complete your chart

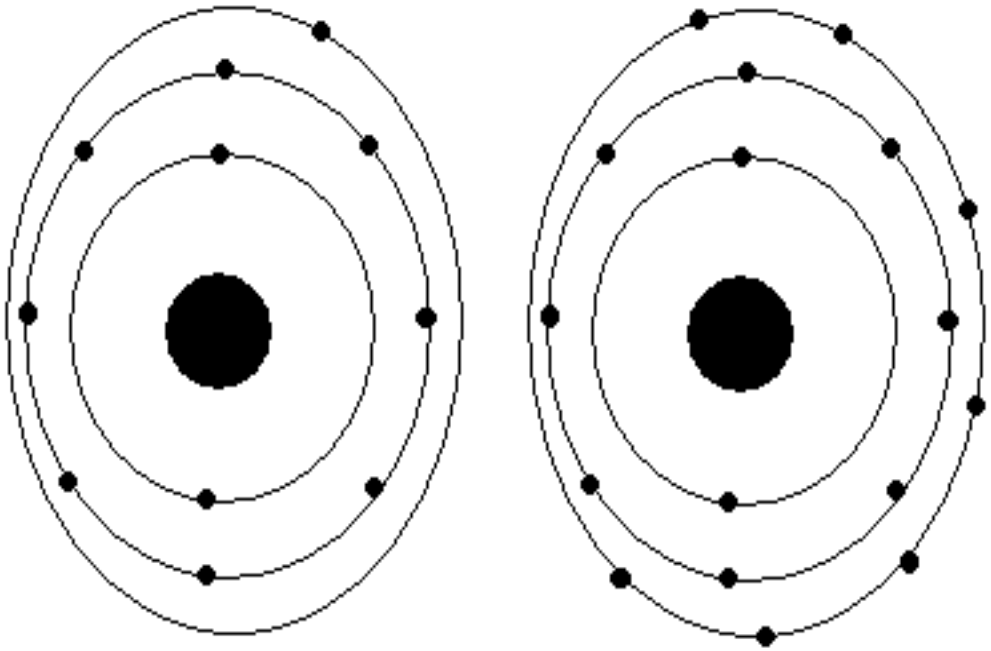
- Write in symbols and color each family a different color.

What does it mean to be reactive?

- We will be describing elements according to their reactivity.
- Elements that are reactive bond easily with other elements to make compounds.
- Some elements are only found in nature bonded with other elements.
- What makes an element reactive?
  - An incomplete valence electron level.
  - All atoms (except hydrogen) want to have 8 electrons in their very outermost energy level (This is called the rule of octet.)
  - Atoms bond until this level is complete. Atoms with few valence electrons lose them during bonding. Atoms with 6, 7, or 8 valence electrons gain electrons during bonding.

Sodium

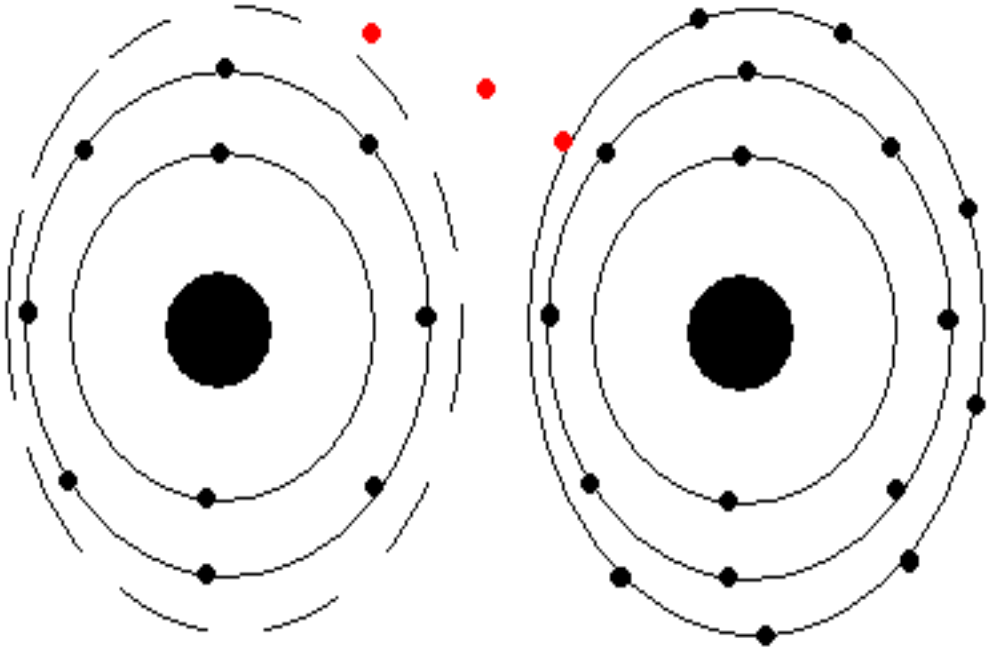
Chlorine



1 valence electron

7 valence electrons

Sodium Chlorine



Sodium loses one electron.
Chlorine gains one electron.

Sodium Chloride