ACTIVITY IDEAS FOR CHAPTER 1

1) GROUP GAME: "Symbol Jars"

The purpose of this game is to learn the letter symbols of some of the common elements. Students do not need to have any previous knowledge. If players do already know some of the symbols, they can still play along with those who are beginners and just focus on the symbols that they don't know. More difficult symbols can always be added to the mix.

NOTE: This game is similar to the fishing game in chapter 2. If you are short on time, you might want to play just one or the other.

You will need: photocopies on card stock, scissors, pencils or crayons

Set up:

Photocopy the pattern page, (the empty bottles, page 92), onto white card stock. Make enough copies so that you have a bottle for each element you want to learn. Cut out the bottles. Write an element's symbol on the bottle, then write the name of the element on the back. (Important: Make sure you don't use anything that will bleed through to the other side! Also, don't press too hard, or your letters might show through to the back. This isn't the time to practice your engraving skills!) You could also reverse this, and put the name on the front and the symbol on the back. Either way is fine.

NOTE: If you are making several copies of the game so that you can play it with a class, make each set of cards a different color. If some cards get mixed up while the students are playing, they will be easy to sort back into their sets. (You won't end up with two of something in one set and none in another.)

How to play:

Before you begin, make sure each player has a little slip of paper with his name on it. Lay the jars out on the table in random fashion. Each player must "call" the jar he wants to play by saying the letter symbol. For example, a player might say, "C." Then the player has a choice: he can either "guess" or "peek."

If the player chooses "guess," he must say the name of the element that is represented by that symbol. After he says the name, he checks his answer by turning over the jar and reading the name on the back. If he is correct, he gets to pick up that jar and keep it. If not, he must leave the jar on the table.

If the player doesn't know a symbol and wants to learn it, he chooses the "peek" option. The player still begins by "calling" the jar he wants to play by saying the letter symbol. Then the player states his option, "peek," and turns the jar over to read the name on the back. After returning the jar to its original position, the player may then "reserve" the jar for his next turn by putting his slip of paper (with his name on it) on top of the bottle. No other player may call that jar while the name slip is on it. When that player's next turn comes around again, he can call that jar but this time use the "guess" option (assuming he does remember the name on the back—if he doesn't, he can always use the "peek" option again). If he guesses correctly, he keeps the jar.

The game is over when all the jars have been taken.

NOTE: If you are working from a paperback copy of this book, not a digital download, and you would like a digital file so that you can print these patterns using your computer's printer, go to www.ellenjmchenry.com, click on FREE DOWNLOADS, then on CHEMISTRY, and then you will see a link for "Printable pages for The Elements curriculum."

2) GROUP GAME: "Quick Six" (Round one—we'll play it again later with more cards!)

The purpose of this game is to become familiar with the names and numbers of the elements from hydrogen to xenon. Players do not need any previous knowledge for this game.

You will need: scissors, photocopies of the pattern pages (93-98) on white card stock, and colored pencils if you would like the students to color the cards (I suggest using the digital version of the curriculum to print the cards on your computer's printer, or get them printed at a print shop. If you need a digital file, see the note above, in italics.)

Set up:

Cut apart the cards. If you would like the students to add color to the cards, provide colored pencils and some extra coloring time.

How to play:

The object of the game is to be the first player to collect six cards.

Decide which player will be the "caller." This player must read from the list below instead of being one of the card players. If an adult is supervising the game, this is the obvious adult job. An adult caller may want to choose particular attributes from the list below to emphasize facts recently learned. It is easiest to go down the list in order, but the caller need not go in order, and may also use items from the list more than once. Feel free to add your own ideas to the list given below!

Each card player receives five cards, which he places face up in front of him. The rest of the cards go face down in a draw pile. The caller reads one of the attributes from the list (the first on the list if they are going in order). Each player looks at his five cards to see if he has a card that has that attribute. If he does, he slaps his hand down on the card. The caller looks to see who is the first player to slap his hand down. That player then shows the card under his hand. If the caller agrees that this card qualifies, then the player may remove that card from the line up and put it face down into a "keeper" pile. Then he draws a card from the draw pile to replace that card and restore him to five cards, face up.

NOTE: There's a chance that a student might know extra information about an element that is not on the card. If the adult in charge determines that the student's answer is accurate, I'd recommend allowing the student to use the information.

The caller then reads off another attribute from the list and the game continues in this manner until one player has six cards in his "keeper" pile. If no player has a card that qualifies, the caller simply goes on to the next one on the list.

NOTE: You might have to institute a rule that says only one slap per round. If they slap and get it wrong, the other players get to guess again, but they don't. Sometimes students slap before they read the card carefully. Using this rule will prevent careless slapping.

If you reach the end of the list below, just start over at the beginning again. (Or, better yet, add your own clues.)

A single game could take as little as 5-10 minutes, so play multiple games. You can switch callers between games.

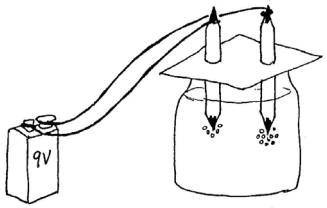
Atomic number has a 3 in it
Name has two syllables
Used in lasers
Has something to do with the color green
Named after someplace in Scandinavia
Has something to do with teeth
Starts with the letter C
Atomic number has a 5 in it
Name has something to do with color
Used to make tools of some kind
Is named after a city (not a country)
Name has three syllables
Atomic mass does not contain a 0
Is used to make jewelry
Named after a country
Used for something that burns
Named after something in the solar system
Atomic number has a 7 in it
Is named after a country (not a city)
Used in fireworks
Has something to do with bones
Name starts with a vowel
Gemstones are made from it
Atomic mass is greater than 100
Is named after a country (not a city)
Name has a double letter, such as "dd" or "ss"
Symbol has only one letter
Atomic symbol contains a vowel
Is used to make some kind of medicine
Used in steel production
Used to repair the human body
Used in light bulbs
Is found as a gas in the air around us
Has something to do with eyes
Conducts electricity
Atomic mass is less than 50
Last three letters of the name are I-U-M
Name is from a Latin word
Is used in batteries or fuel
Has something to do with glass
First letter of name does not match first letter of the symbol
Is found in some kind of gemstone
Name begins with the letter S
Name ends with letters O-N
Name starts with the "K" sound (C or K)
Is used in magnets of any kind
Used in something that makes light
Used to make coins
Symbol contains one of these letters: X, Y, or Z
Name has four syllables
Number has a 1 in it
Atomic mass contains a 1
Name begins with the letter R
Atomic number is a prime number
Is mixed into metal alloys

3) LAB DEMO: "A Recipe in Reverse" (Electrolysis of water)

In this experiment, you will start with H_2O and "break" it into its ingredients: H and O.

You will need a clear container, a 9V battery, a piece of cardboard (cereal box is fine), aluminum foil, tape, two pencil stubs (sharpened at both ends), water, salt

How to set it up:



Think about how important the discovery of electricity was to chemists. If there was no way to separate water into its ingredients, how would you know it wasn't an element? Figuring out which substances were elements and which were not was a major puzzle for hundreds of years. Elecgtricity was necessary for the discovery of a number of elements including sodium, potassium and magnesium.

1) Put 2 teaspoons of salt into the cup of water and stir until dissolved.
2) Cut strips of aluminum foil and roll them into "wires." Curl one end around a battery terminal (tape in place if necessary) and put the other end around the sharpened pencil point and secure with tape. Make sure the graphite of the pencil is in good contact with the foil.
3) Push the pencils through the cardboard, as shown, so that the bottom points are in the water. (You can even strip off some of the wood with an X-acto knife if you want to, exposing more graphite. The more graphite showing, the more bubbles you will get.)

What will happen:

You will see bubbles forming around the ends of both pencils. If you look carefully, you will notice that there are about twice as many bubbles on one pencil as the other. Have the students guess which is which, by thinking about the recipe: H_2O. (Hint: The recipe says that for every oxygen atom there are two hydrogen atoms.)

4) SONG: "The Chemical Compounds Song" activity

Here is an activity you can do with this song. It can be done in pairs or in a group, whatever works in your situation. Use the song as the chant for any type of hand-slapping game, such as "Miss Mary Mack." ("Miss Mary Mack, Mack, Mack, all dressed in black, black, black...") The students may be able to suggest their favorite hand-slapping patterns. Any hand slap pattern will work, as long as both partners are doing the same pattern. For a large group, they can sit in a circle and slap thighs, then clap, then turn hands to the side and slap hands of person on their left and right simultaneously.

Also, there is a funny music video to watch on the YouTube playlist, made by a family who did this curriculum a few years ago. (www.YouTube.com/TheBasementWorkshop, click on "Show all playlists," then on "The Elements."

5) "MAKE FIVE" A game about mineral recipes

This game is recommended for older students, or those who are very enthusiastic about rocks and minerals. If "Symbol Jars" was enough, you can skip this game. You could also wait and play this game after the next chapter.

By definition, a mineral has a definite chemical composition (a recipe). In this game you will be introduced to the recipes for some common minerals. It's also an opportunity to keep on learning all those letter abreviations (symbols).

You will need: copies of the pattern pages copied onto card stock, scissors, and white glue (if you are assembling the paper dice) If you are using wooden cubes for the dice, you'll also need one or more markers.
(In a pinch for time, just take a fine point marker (red?) and write on real dice. Everyone can ignore the dots.)

NOTE: If you can get three wooden cubes, this is the best option. Most craft stores sell wooden cubes by the "each" or in small units and fairly inexpensively. If you want this game sturdy enough to survive future uses, consider using wooden cubes.

Preparation:

1) Cut out the dice patterns (copied onto heavy card stock) and make into cubes, using small dabs of white glue on the tabs. (Or, write the symbols on wooden dice or even regular dice.)

2) Cut apart the 16 mineral cards.

How to play:

Place the mineral cards on the table, face up, so they form a 4 x 4 square. Each player will have a turn rolling all three dice at once. The goal is to roll the ingredients to form a mineral. (One roll of the three dice per player per turn.) For example, if the first player rolls: Cu, Fe, and S, he should notice that those are the ingredients of chalcopyrite. Therefore, that player picks up the chalcopyrite card. If the next player rolls Ca, C, and WILD, he could make the wild card into O, and be eligible to pick up calcite.

The first player to collect five cards wins the game.

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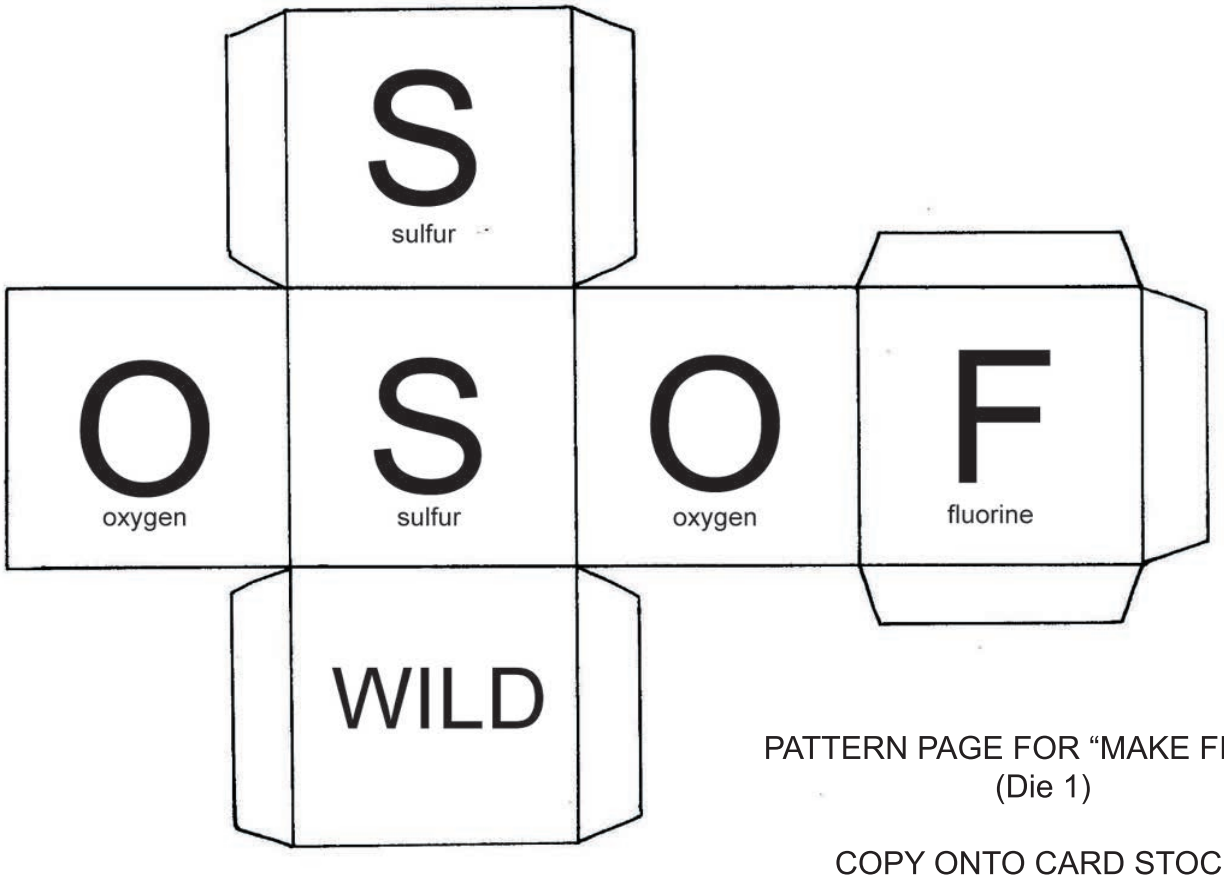
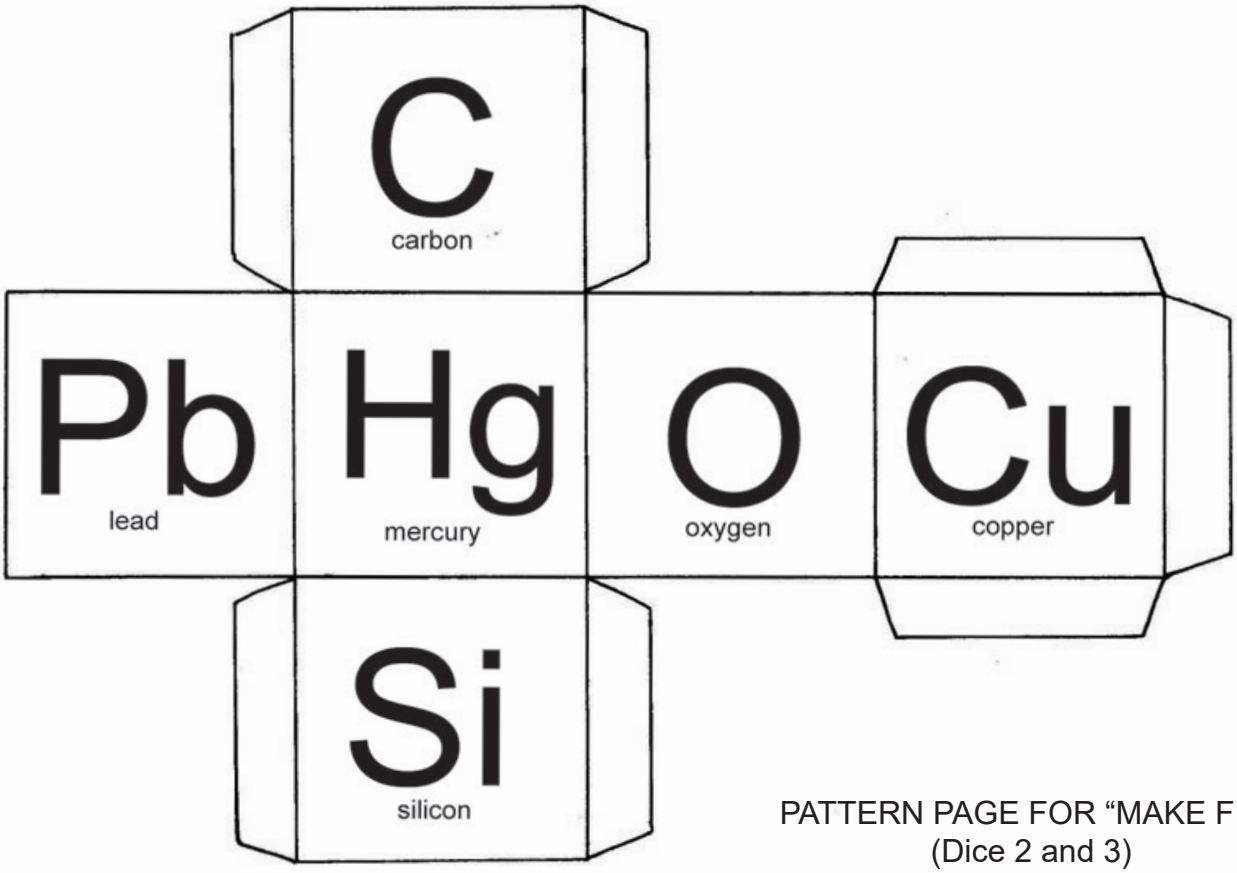


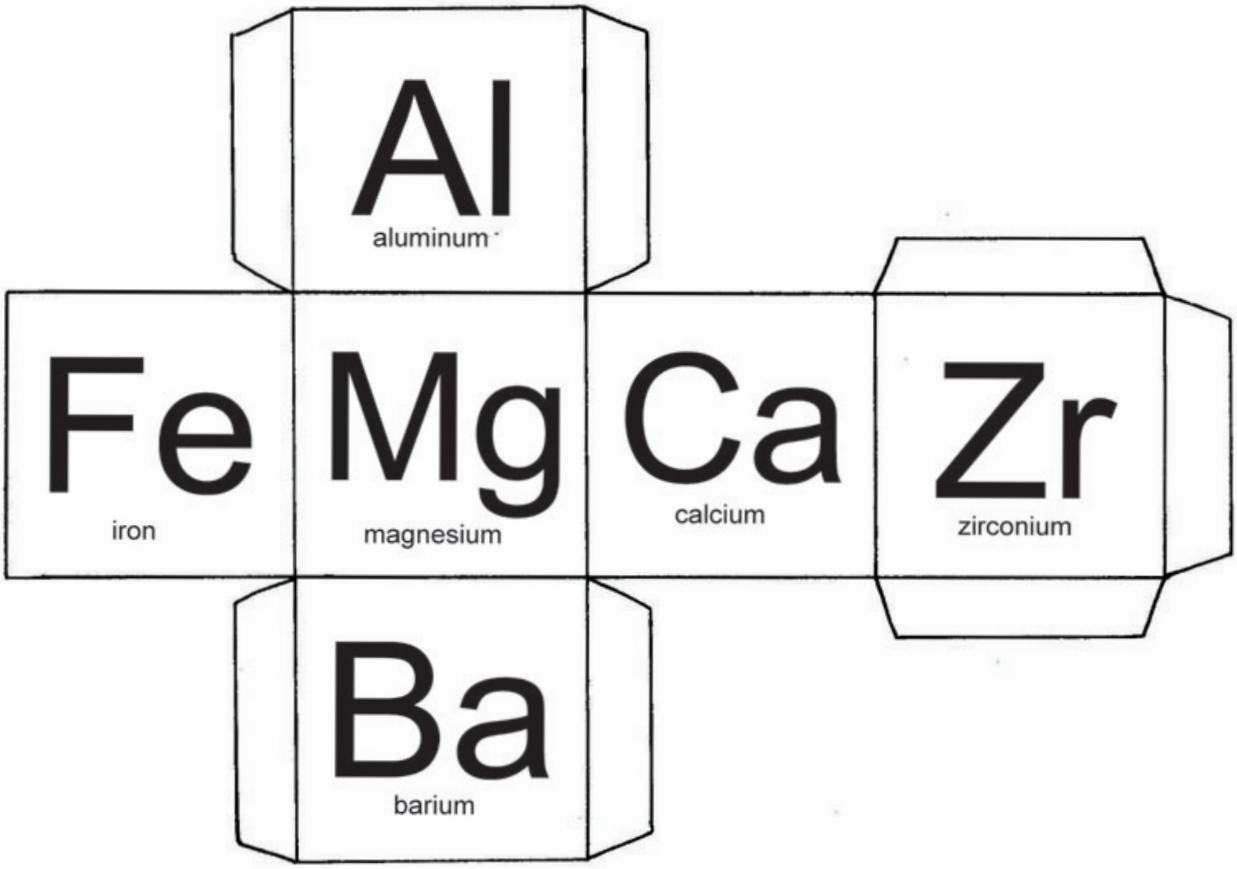
PATTERN PAGE FOR "MAKE FIVE"
(Die 1)

COPY ONTO CARD STOCK



PATTERN PAGE FOR “MAKE FIVE”
(Dice 2 and 3)

COPY ONTO CARD STOCK



barite

$BaSO_4$

Often found in limestone or hot spring areas. Usually white or light brown. Sometimes crystalizes into rose shapes, which are popular with collectors.

zircon

$ZrSiO_4$

Found in nearly all igneous rocks, although in very small amounts. Because it is so hard, it is often used as a gemstone in jewelry.

hematite

Fe_2O_3

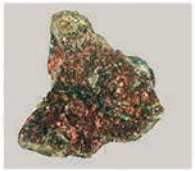
Hematite is a major ore (source) of iron. The name "hematite" comes from its blood-red color ("hema" means blood).

cinnabar

HgS

Cinnabar has a reddish color and is very dense (heavy) because of the mercury (Hg). Pure mercury is a liquid at room temperature, but it is a solid when bound to sulfur.

cuprite



Cu_2O

Cuprite forms cubic crystals. It is sometimes called "ruby copper" because of its color. When exposed to air it changes to CuO.

fluorite

CaF_2

Fluorite is used in the production of steel. It has a glassy luster and can look similar to a quartz crystal, except for its tetragonal (4-sided) shape.

quartz

SiO_2

Quartz is used in electronics, as a gemstone, and in the manufacturing of glass (where it is the main component). Sand is made of very tiny pieces of quartz.

galena

PbS

Galena is very dense (heavy) because of the lead in it. During the era of musket rifles, galena was used as the source of lead to make musket balls.

pyrite

FeS_2

This mineral is often called "fool's gold" because of its golden color and shiny luster. It has no actual gold in it. It leaves a black streak, not gold.

FIRST PATTERN PAGE FOR "MAKE FIVE"

COPY ONTO CARD STOCK

corundum

Al_2O_3

Corundum is very hard. It is so hard that it is used in industry as an abrasive (like sand paper). Blue corundum is called a sapphire and red is a ruby.

talc

$Mg_3Si_4O_{10}$

Talc is extremely soft. In fact, you can scratch it with your fingernail! Talc is the main ingredient in talcum powder (used to dry off after a shower).

calcite

$CaCO_3$

Calcite is the main ingredient in limestone. It is one of the most common minerals in the world. Caves are made of limestone.

gypsum

$CaSO_4$

Gypsum is a soft mineral. It is one of the main ingredients in plaster and plasterboard. One type of gypsum is called alabaster and was carved by ancient peoples.

chalcopyrite

$CuFeS_2$

Chalcopyrite is pinkish-purple with flecks of gold. It is found wherever copper is mined. The copper can be taken out of it by using chemical processes.

epsom salt

$MgSO_4$

This mineral dissolves into water very easily. It is often used in medical treatment of wounds on hands and feet. It helps in the healing process.

diamond/graphite

C

Strangely enough, both priceless diamonds and the stuff in your pencil are made of the same thing: pure carbon. The difference is how the atoms are bonded together.

SECOND PATTERN PAGE FOR “MAKE FIVE”

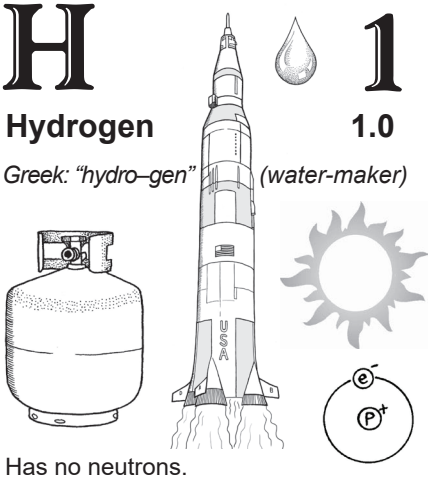
COPY ONTO CARD STOCK

PATTERN PAGE FOR “SYMBOL JARS” COPY ONTO CARD STOCK

H 1

Hydrogen **1.0**

Greek: "hydro–gen" (water-maker)

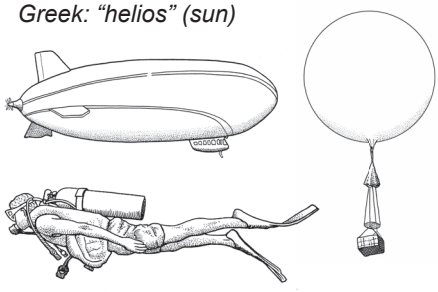


- Has no neutrons.
- Is the fuel for stars (including our sun)
- Used in rocket fuel and fuel cells
- Combines with O to make water.
- Combines with C to make natural gas.

He 2

Helium **4.0**

Greek: "helios" (sun)



- Used in balloons, blimps and scubing diving tanks.
- Discovered in the sun in 1895 using a spectrometer.

Li 3

Lithium **6.9**

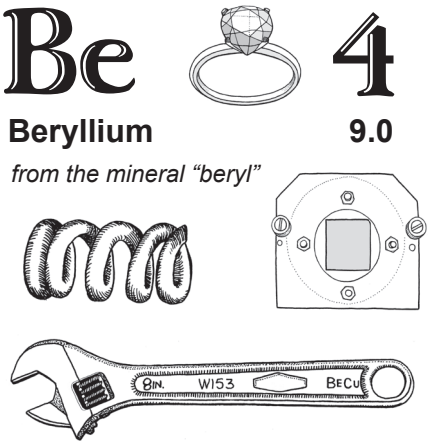
Greek: "lithos" (stone)

- Used in batteries, lubricants, medicines, red fireworks, and nuclear bombs.
- Is never found by itself in nature (it's always in a compound).

Be 4

Beryllium **9.0**

from the mineral "beryl"



- Found in emeralds.
- Is mixed with copper to make "beryllium bronze," for making tools and parts that won't create sparks.
- Used for "windows" that let x-rays pass.

B 5

Boron **10.8**

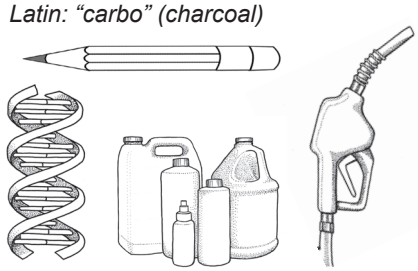
from the compound "borax"

- Used to make heat-resistant glass.
- Used in boric acid antiseptic eye wash.
- Is a main ingredient in Borax® washing powder
- Used in nuclear power plants.
- Combines with white glue to make "slime"

C 6

Carbon **12.0**

Latin: "carbo" (charcoal)



- Diamonds, graphite (pencil "lead") and coal are all made of carbon.
- Carbon makes long chains (polymers) that are the basis of fossil fuels and plastics.
- Carbon is necessary for organic molecules found in living organisms.

N 7

Nitrogen **14.0**

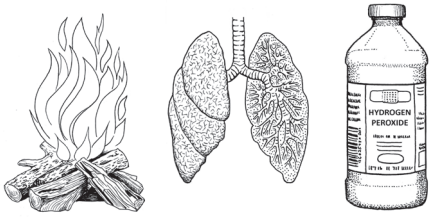
Greek: "nitron" (the mineral saltpetre)

- Most of the air we breathe is nitrogen.
- Used in air bags in cars.
- Combines with H to make ammonia (found in some cleaning products)
- Plants need N to stay green.
- Found in gun powder.

O 8

Oxygen **15.9**

Greek: "oxy-gen" (acid-maker)

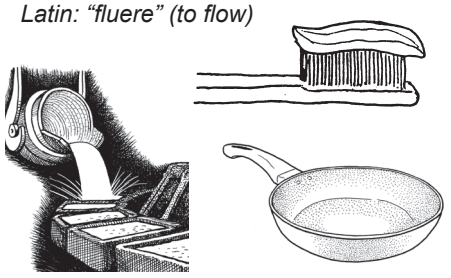


- Combines with silicon to make sand
- Necessary for respiration and combustion.
- H_2O is water.
- H_2O_2 is hydrogen peroxide.

F 9

Fluorine **18.9**

Latin: "fluere" (to flow)

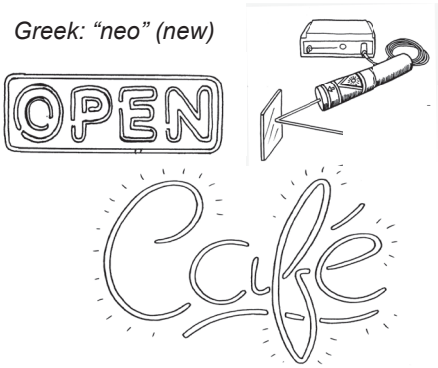


- Combines with Ca to make fluorite.
- Is put into toothpaste to fight cavities.
- Combines with C to make Teflon.®
- Used as flux in steel making (makes hot metal flow better).

Ne 10

Néon **20.1**

Greek: “neo” (new)

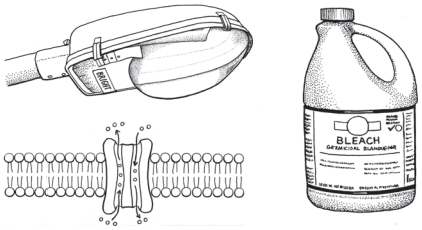


- Used in neon lights and lasers.
- Neon doesn’t bond to other elements.

Na 11

Sodium **22.9**

from soda ash



- Combines with Cl to make table salt.
- Used in street lights.
- Found in bleach, NaClO.
- Found in sodium/potassium pumps in cell membranes.

Mg 12

Magnesium **24.3**

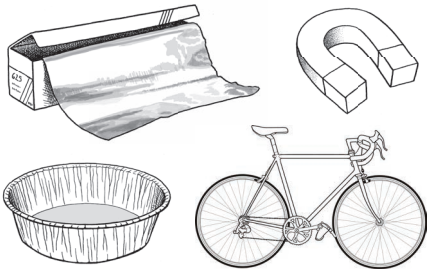
from Magnesia, in Greece

- Used in white sparklers.
- Found in Epsom salt, $MgSO_4$.
- Is the central atom in chlorophyll (the green molecule in leaves).
- Used to make fire starters.

Al 13

Aluminum **26.9**

from the compound “alumina”

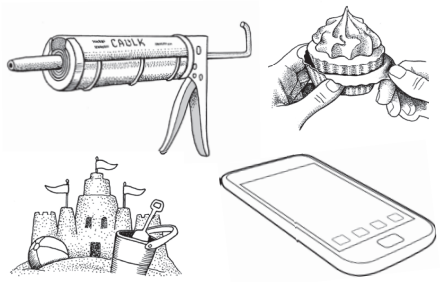


- Used to build bicycles and airplanes
- Al_2O_3 is the mineral (gem) corundum.
- Used for foil, and for beverage cans.
- Used in AlNiCo magnets.

Si 14

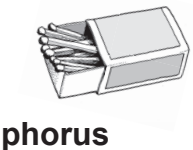
Silicon **28.0**

Latin: “silex” (hard stone, boulder)



- SiO_2 is quartz (which can form sand).
- Used to make microchips.
- Used to make silicon rubber products like caulk and flexible baking dishes.

P 15

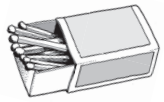


Phosphorus **30.9**

Greek: “phosphoros” (bringer of light)

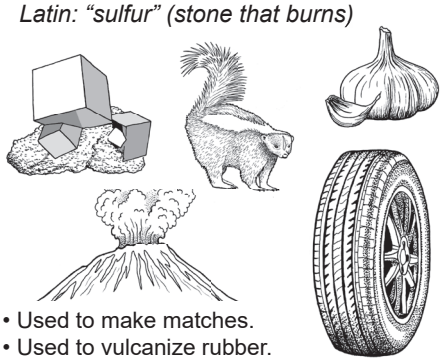
- Found in matches and some cleaners.
- Necessary for strong bones and teeth
- Phosphoric acid is often in fizzy drinks.
- Is an ingredient in many plant fertilizers.

S 16



Sulfur **32.0**

Latin: “sulfur” (stone that burns)

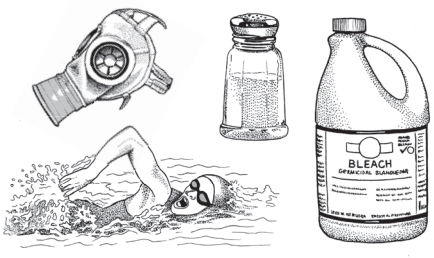


- Used to make matches.
- Used to vulcanize rubber.
- Volcanoes produce gases containing sulfur.
- Makes skunks and garlic stinky.
- Combines with Fe to make the mineral pyrite.

Cl 17

Chlorine **35.4**

Greek: “kloros” (light green)

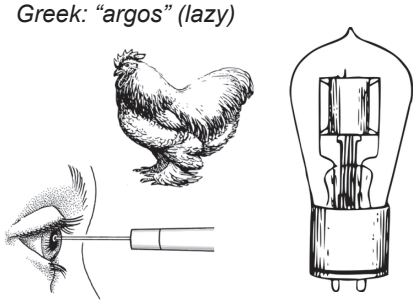


- Bonds with Na to make table salt.
- Used to disinfect swimming pools.
- Is an ingredient in PVC plastics.
- Found in bleach, NaClO
- In pure form is a poisonous green gas.

Ar 18

Argon **39.9**

Greek: “argos” (lazy)

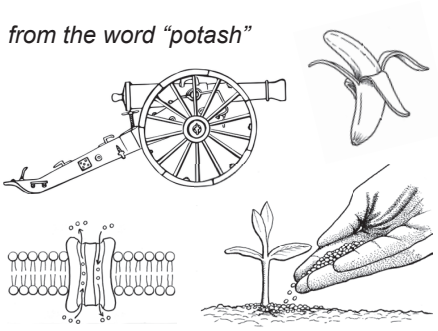


- Replaces air in lightbulbs.
- Used to make lasers for eye surgery.
- Used to butcher chickens.
- Doesn’t form any molecules.

K 19

Potassium **39.0**

from the word "potash"

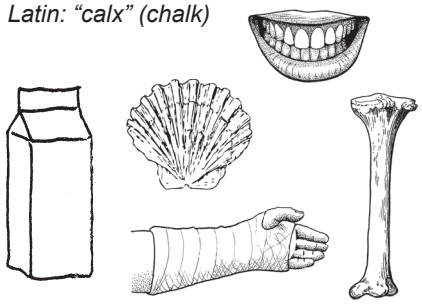


- Used in fertilizers.
- Is an ingredient in gun powder.
- Bananas contain a lot of potassium.
- Is found in mineral orthoclase feldspar.

Ca 20

Calcium **40.0**

Latin: "calx" (chalk)

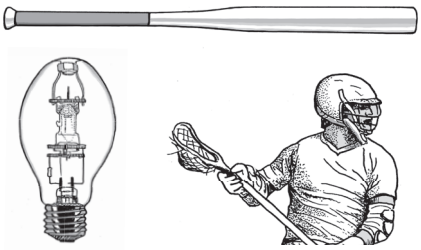


- Found in chalk, limestone and plaster.
- Needed for strong bones and teeth.
- Milk and broccoli have lots of calcium.
- Seashells are made with $CaCO_3$.

Sc 21

Scandium **44.9**

named after Scandinavia

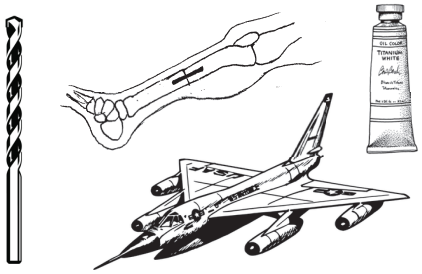


- Used in high intensity light bulbs.
- Used in large television screens.
- Alloys containing Sc are used to make sports equipment.

Ti 22

Titanium **47.9**

named after the Greek Titan gods

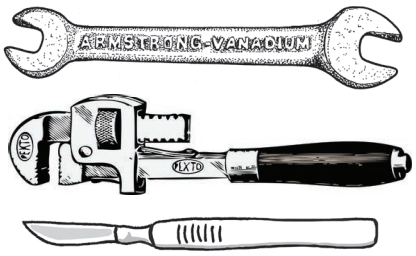


- Used to repair bones.
- Used to make white pigment for paint.
- Alloys are used to make airplane engines, drill bits and tools.

V 23

Vanadium **50.9**

after the Scandinavian goddess Vanadis

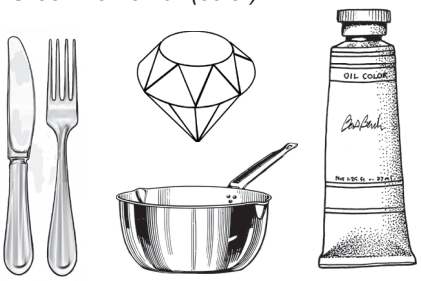


- Added to steel to make very durable and corrosion-resistant tools, springs and engine parts

Cr 24

Chromium **51.9**

Greek: "chroma" (color)

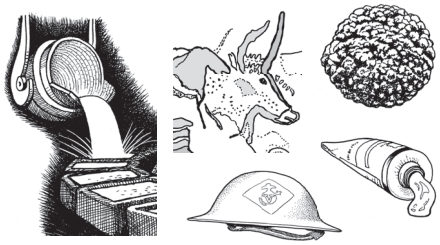


- Gives rubies their red color.
- Used to make red, green and yellow paint.
- Used as a shiny coating for metals.
- Added to steel to make it "stainless."

Mn 25

Manganese **54.9**

Latin: "magnes" (magnetic)

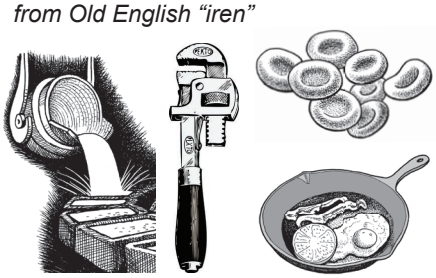


- Used to remove impurities from steel.
- Manganese nodules are on ocean floor.
- Found in vitamin B1.
- Is the "Mn" in YInMn blue pigment.
- Found in pigments in cave paintings.

Fe 26

Iron **55.8**

from Old English "iren"



- Discovered in ancient times.
- Used in steel and in magnets.
- Fe will rust if O_2 and H_2O are present.
- Used to make cast iron cooking pans.
- Red blood cells are red due to iron.

Co 27

Cobalt **58.9**

German "kobald" (evil gnomes)

- Used in AlNiCo magnets.
- Used in making drill bits and razors.
- Can be used to color glass deep blue. or to make blue glaze/paint for pottery.

"Quick Six" pattern page 3

Copy onto white card stock

ACTIVITY IDEAS FOR CHAPTER 2

1) GROUP GAME: Play the element fishing game

Overview of game: This game can be played with multiple skill and age levels. The rules are constructed so that students who have no previous knowledge of the elements can play with those who do. The rules are similar to the "Symbol Jars" game from chapter 1, so if you played that game then this one will not require a lot more initial instruction. (The kids won't mind the repetition. I've never had any student complain about playing both jars and fish.)

You will need: copies of the fish pattern page, printed onto heavy card stock if possible. You may use as few or as many of the elements in your game as you wish. Just copy enough fish for the number of elements you want to use.

You will also need: scissors, pencils or crayons, string, paper clips, little slips of paper (one per player), at least one pole of some kind (you can make as many fishing rods as you want to), at least one magnet (one magnet per pole), an area marked off to be the "pond"

TIP: When I've played this with a large group, it turns into total chaos if there are too many fishing poles. If the kids have a rod in their hands, they WILL fish whether it is their turn or not. I recommend small groups (no more than 4-5 kids per "pond") with only one rod to pass around, two at most.

OPTIONAL: Have students trade in their paper fish for edible fish crackers at the end of the game.

Set-up:

1) Cut out the paper fish. Have the students write the name of an element on one side of the fish and its symbol on the reverse side. (NOTE: Make sure you use a writing implement that does not bleed through the paper.) If you have limited class time, you may want to have the fish pre-labeled before class. If you want to make your fish durable, you could laminate them.
2) Put a paper clip on the nose of each fish. Make a fishing pole from a rod (even a yardstick will do) and a string, and put a magnet on the end of the string.
3) Mark off an area that will be the fishing pond. If you want to get fancy, you can use a plastic wading pool. (I've used blue painter's tape on both hard floors and carpets.)
4) Each player needs a slip of paper with his or her name on it.
5) After the fish are made, put them into the pond so that either all the names or all the symbols are facing up. The game seems to be easier to play if the symbols are facing up. We've found that reading the name and guessing the symbol is a little more difficult.

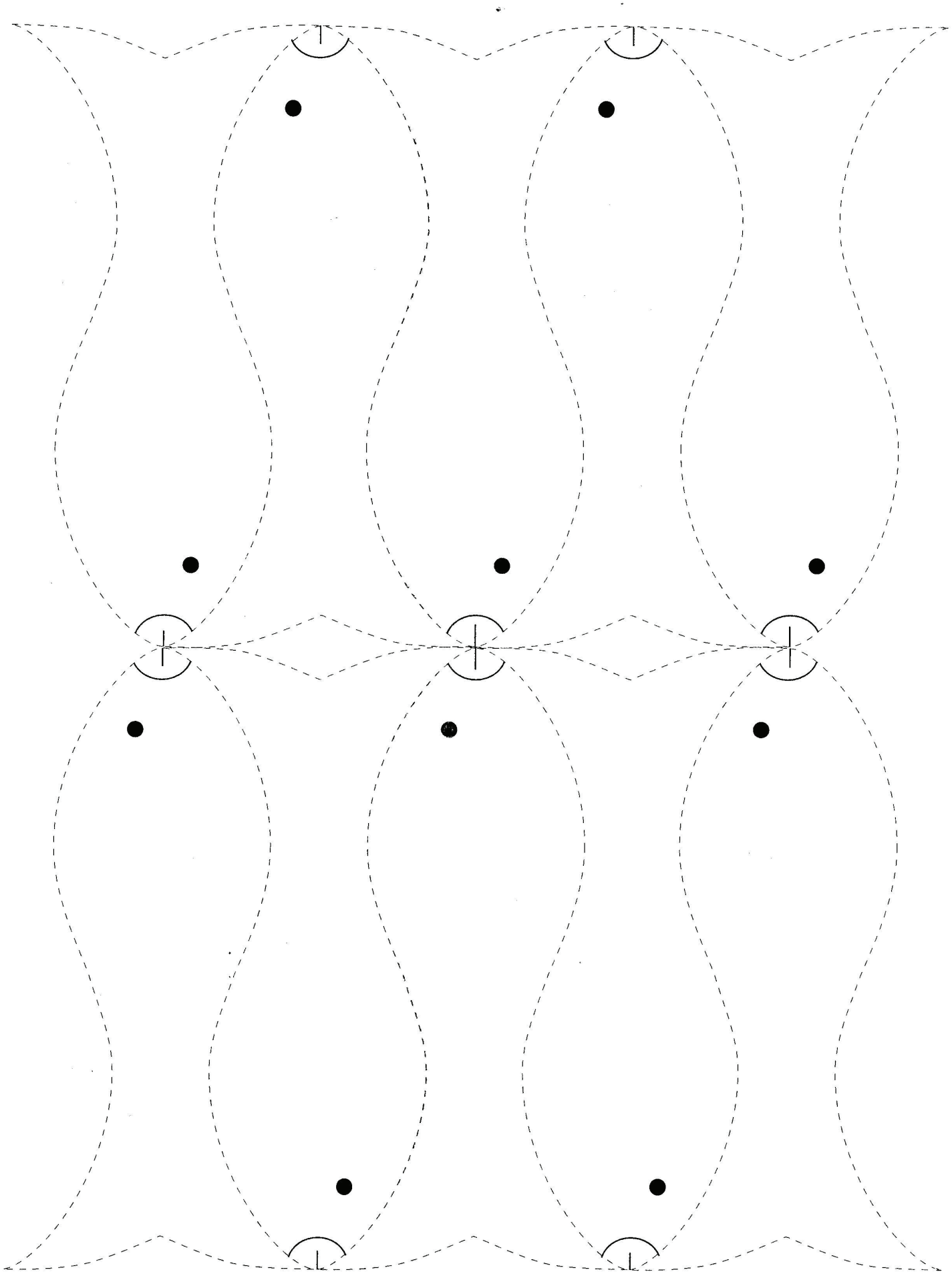
How to play:

The rules are very similar to "Symbol Jars." The swinging strings add a new dimension to the game, in that you don't always bring up the fish that you called out. Oh well, it's part of the game!

Each player must "call" the fish before he puts his rod in, by saying the name or letter on it. He must also choose one of two options: "guess" or "peek" If he chooses "guess" this means that he will try to say what is on the reverse side before he pulls the fish out of the pond. After guessing, he reels in the fish and looks on the back. If he is right, he keeps the fish; if not, the fish goes back in the water. The other option, "peek," is for when the player has no idea of the right answer and needs to learn it. The player still "calls" the fish, but then says "peek." After reeling in the fish, the player reads the reverse side out loud. After the "peek" option, the player may then put his name slip under the paper clip, before returning the fish to the pond. This reserves the fish for him until his next turn. No other player may catch his fish in the interim. On his next turn, that player will probably want to use the "guess" option, remembering what he read on the back of the fish last time. If he remembers correctly, he keeps the fish. If not, the fish goes back in the pond (with no name slip).

The game is over when all the fish are gone. You could play for a winner by counting up who has the most fish, or you can make the game non-competitive and simply give the players an edible reward for each fish they caught.

Even my middle school students enjoy fishing.



2) ACTIVE GROUP GAME: The Periodic Table Jump Rope Rhyme

You will need: jump ropes and the audio track (www.ellenjmchenry.com/audio-tracks-for-the-elements)

Note: You can have the students use individual ropes, or you can do it as a group activity with one long rope and a "turner" at each end. This second method is nice to start with because the turners and the players who are not jumping can be the ones to recite the elements while the jumper concentrates on jumping. I have found that it is not hard at all to elicit very loud group chanting as players jump. It's kind of natural to join in with a group chant. So the students spend a lot of time chanting the rhyme over and over again. They can't help but remember at least some of it eventually.

You might want to start by just listening to the audio track to catch on to how the chant goes. After a few times you can dispense with the audio track and have the students do their own chanting. The game will be to see who can jump all the way to krypton without missing the rope. A player who misses the rope has to start back at hydrogen again (which is GREAT because that makes everyone review!). You might want to allow kids who miss before beryllium to get another try. NOTE: If you have kids who are shy about doing "overhead" jumping, you can do what we called "swayzees" (way back in the 1970s and 80s). Just swing the rope back and forth, never letting it go higher than waist high.

3) MATCHING CARD GAME: A way to review the info from the Chemical Compounds Song

You will need: picture cards showing the items named in the song (water, salt, bleach, rust, etc.) and cards with the chemical recipes written on them. Cards should all be the same size and made out of card stock, if possible, so that the writing does not show through on the back.

NOTE: Apologies that the pictures can't be provided, but there could be copyright issues involved. However, they are easily found in seconds with an Internet image search. Just take a few minutes to download and print them however your computer is set up to do such a task. I put 6 pictures on a page, but you can do more or less.

ALSO NOTE: If you want to make the card game a little harder for older students, add these chemical formulas: H_2O_2 (hydrogen peroxide), N_2O (nitrous oxide or laughing gas), H_2S (hydrogen sulfide, the smell of rotten eggs), and NH_3 (ammonia, the smell of glass cleaning products or wet diapers).

How to play: Use standard "Memory match" game rules.

ACTIVITY IDEAS FOR CHAPTER 3

1) ACTIVE GROUP GAME: Human model of atom (a good outdoor activity)

You will need: as many players as possible, and a large outdoor (or indoor) space.

How to play:

1) All players will represent electrons. The adult (or a stationary object) will represent the nucleus. Assign each player either a number (starting from one and going up as high as you have players). This number corresponds to an element. 1=hydrogen, 2-helium, etc.
2) Explain that this model will be a "solar system" model, with the electrons going in circles around the nucleus.
3) As the number/name of each element is called out, the player who has been assigned that element comes to join the atom. The first two players must run, without bumping into each other, in a fairly tight circle, not too far from the nucleus. The third player, when called, must start a new circle, farther out than the first one. Then players are added, one at a time, until the second ring has eight in it. If you have more players, start a third ring.
4) While players are being added, the ones already in the atom must keep going.
5) For an added learning bonus, tell your players that you'll count to ten and in that time they must circle the nucleus one time. Just one time. They will find, of course, that the players in the outer ring will have to run very fast in comparison with the ones close to the nucleus. This analogy can be helpful when trying to explain how electrons can be "high energy" (a concept you meet in photosynthesis, cellular respiration). The outer shell electrons have more energy than the inner ones. If an electron gets zapped by a photon of energy it can jump to a higher shell. It can't stay there, though and when it comes back down it must release that energy again, and sometimes that energy is light we can see. (This is how glow-in-the-dark pigments work.)
   NOTE: While adding more players, keep an eye on the ones already running and make sure they stay at opposite ends of the circle and don't run into each other. Electrons never, ever, ever run into each other! They like to be in pairs, but at the same time, they like to be on opposite sides.

2) ACTIVITY: The Quick and Easy Atomizer

This can be used as a group activity. The directions are in the student booklet.

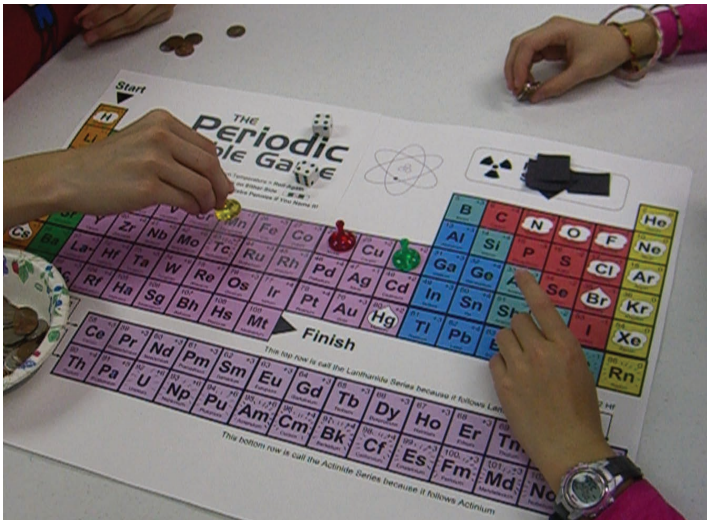
3) ACTIVE GROUP GAME: Jump Rope Rhyme Challenge, Round 2

Do the jump rope challenge again, only this time let the students go as far as they can on the Periodic Table. The jumper will not be the one reciting. The players who are not jumping are responsible for reciting. Use the rhyme up to krypton, then start saying the elements in order after that.

You may want to go over pronunciation ahead of time. You can use a dictionary, but there is also a helpful pronunciation guide at the beginning of this book. Also if you type "how to pronouce [your word]" into YouTube, you will be offered several pronunciation guides.

ACTIVITY IDEAS FOR CHAPTER 4

1) TABLE GAME: The Periodic Table Game ("Race to Rutherfordium")



You will need: copies of the four pattern pages, assembled to make the Periodic Table, coins (about 5 pennies, 5 nickels, 5 dimes, and 1 quarter per player), a tuna can or small plastic container of similar size, a pair of standard dice, some tokens (one per player, and they don't have to be real game tokens, you can use anything), and some black paper squares the size of one space on the game board (two rectangles per player)

You may also want to make copies of the list of names and places for the students to study BEFORE the game starts. Once the game starts, no peeking at the list. Of course, the list may have to be consulted during the game to check answers.

NOTE: Again, if you need a digital file to print from, you can find one at www.ellenjmchenry.com in the chemistry section of the free downloads.

About the game board:

The number in the upper right hand corner of each square is the valence number. It is the number of electrons the element would like to receive or give away. Many elements (especially in the middle of the table) have more than one valence number. I've chosen just to list the highest valence for each element. It simplifies the game considerably and makes the mathematical pattern of the table more obvious. However, you may want to make your players aware that in reality many of the elements can have more than one valence number. In this game, the elements in each column end up displaying the same valence, which is a basic concept in learning to understand the Periodic Table. The word "periodic" means it has repeating patterns, and the valencies are one of these patterns. Notice that the last five elements do not have a valence number listed. These elements only exist for a fraction of a second and therefore their valence cannot be determined.

The large letters in each box are the symbols for each element. Underneath the symbol is the name of the element.

Most elements are solids at room temperature. Notice that the elements that are liquids at room temperature are marked with a liquid drop, and those that are gases at room temperature are marked with a gas cloud.

There is a strange break at two places in the Periodic Table. One is after Lanthanum and one is after Actinium. These extra sections are listed at the bottom of the table simply because inserting them in the middle of the table would make the table too wide to fit comfortably on a page. There's no scientific reason for putting them at the bottom--it's simply a graphics decision.

The black and white version of the game is identical to the colorized version (except for the color, of course). The black and white version is for students who love to color, or who will learn more by coloring their own table. The black and white version is also cheaper and easier to reproduce.

How to play:

Before starting the game, players get a chance to study the information page that lists elements named after people and places. You might want to make additional photocopies of it. Once the game starts, no peeking except to check answers.

1) Put all the coins in the can and place it on the circle marked BANK. Put the players' tokens on START. Give each player 5 pennies to begin with.
2) Players take turns moving the number of spaces they roll on the dice. (Use two dice so the game doesn't go too slowly.) Unless your tokens are pretty small, you will probably want to allow only one token per square. Players will have to jump over each other. It's up to you whether to count that hop over another player as one of your actually "hops" or or not. Either way is fine as long as everyone agrees to the rules ahead of time and abides by them while playing.
3) When a player lands on a space, he looks at the valence number, which is in the upper right corner. If it is a positive number, he takes that many pennies from the bank. If the number is negative, he loses that many pennies and must put them into the bank.
4) Certain elements have special features:

   GASEOUS ELEMENTS (indicated by a cloud shape): extra roll

   LIQUID ELEMENTS (indicated by a droplet shape): extra roll

   PRECIOUS METAL: bonus of three pennies (Precious metals include silver, gold, platinum. You may add others to your list if you want to, as long as everyone agrees.)

   RADIOACTIVE ELEMENTS: The radioactive elements have little "shine" lines around their letter symbols. The player must place a square black shield on the spaces before and after that space, to keep other players "safe." No one can land on a black shield. If other players come past while the shields are in place, they simply hop over all three spaces (the two with the black shields and the one in the middle that has a token sitting on it) and keep going with their turn. Those three spaces do not count at all (they do not use up three hops). Just ignore those three spaces as if they were not there. When it is the radioactive player's turn again, he removes the black shields and simply proceeds with his turn.

   ELEMENT NAMED AFTER A PERSON OR PLACE: If a player lands on an element that he thinks was named after a person or a place, he may take a 3 penny bonus if he can name that person or place. If he is wrong, he does not get the bonus, but there is no penalty for guessing.

   LANTHANIDES and ACTINIDES: Don't forget about these rows! After a player lands on lanthanum, he goes down to the lanthanide series. At the end of the row, he hops back up to hafnium. Similarly, after actinium comes thorium. After that row, hop back up to the main table and continue on with rutherfordium. (Often players forget the lanthanides the first time they play the game. If this happens and it's discovered too late to go back, you may want to just have the other players skip the lanthanides also, to make it fair play for everyone.) We don't know much about these rows yet, and they may seem like an annoyance in the game, but we'll find out in chapter 8 how incredibly important some of these are to our modern lifestyle (computers, cell phones, ipads, etc.).
5) At any time during the game a player may "make change," trading in pennies for nickels or dimes. The bank needs to have a good supply of pennies all the time, so when that supply gets low, players must make change to restock the bank.
6) After all players reach Rf, rutherfordium, the game is over. The player with the most money wins. (But everyone wins if you all learn and have fun!) The game does not go all the way to Oganesson because it is already pushing the patience of many players just to get to Rf (or even to Rn).
6) To make the game shorter, end at Radon instead of Rutherfordium.

NOTE: These lists do not include the elements you can't land on in this game.

ELEMENTS NAMED AFTER PLACES:

Americium: America
Berkelium: Berkeley, CA
Californium: California
Cerium: the asteroid Ceres
Erbium: Swedish town of Ytterby
Europium: Europe
Francium: France
Gallium: France (Gall was the ancient name for France)
Germanium: Germany
Hafnium: Hafnia is Latin for Copenhagen, Denmark
Holmium: Stockholm, Sweden
Neptunium: the planet Neptune
Palladium: the asteroid Pallas
Plutonium: the until-recently-a-planet Pluto
Polonium: Poland
Rhenium: the Rhine River area of Germany
Ruthenium: the province of Ruthenia in the Czech Republic
Scandium: Scandinavia
Strontium: Scottish town of Strontian
Tellurium: the planet Earth (the Greek word is Tellus)
Terbium: the Swedish town of Ytterby
Thulium: Scandinavia (the ancient name for Scandinavia was Thule)
Uranium: the planet Uranus
Ytterbium: the Swedish town of Ytterby
Yttrium: again, the Swedish town of Ytterby

ELEMENTS NAMED AFTER PEOPLE, REAL or MYTHOLOGICAL:

Cobalt: kobalds (gremlins)
Curium: Marie Curie, discoverer of radium and polonium
Einsteinium: Albert Einstein
Fermium: Enrico Fermi, a physicist during the World War II era
Gadolinium: Johan Gadolin, a Finnish chemist
Gallium: Lecoq de Boisbaudran, a 19th century chemist (Gallus is Latin for “cock”)
Iridium: Iris, goddess of the rainbow
Lawrencium: Ernest O. Lawrence, a 20th century physicist
Mendelevium: Dmitri Mendeleyev, inventor of the Periodic Table
Mercury: Mercury, mythological Roman god
Nickel: the devil
Niobium: Niobe, the daughter of mythological Greek god Tantalus
Nobelium: Alfred Nobel, inventor of dynamite, and namesake of the Nobel Prize
Promethium: Prometheus, mythological Greek god who gave fire to mankind
Samarium: Vasili Samarsky-Bykhovets, a Russian general
Tantalum: Tantalus, mythological Greek god
Tin: Tinia, mythological Etruscan god (“Sn” comes from its Latin name, stannum)
Thorium: Thor, mythological Norse god of thunder

Start

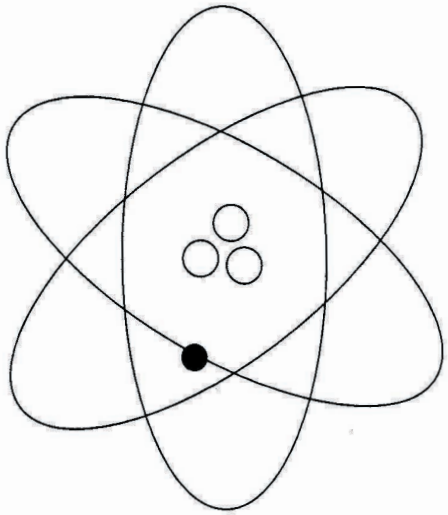
THE Periodic Table Game

Liquid or Gas at Room Temperature > **Roll Again**

Radioactive > **Put up Shields on Either Side** 

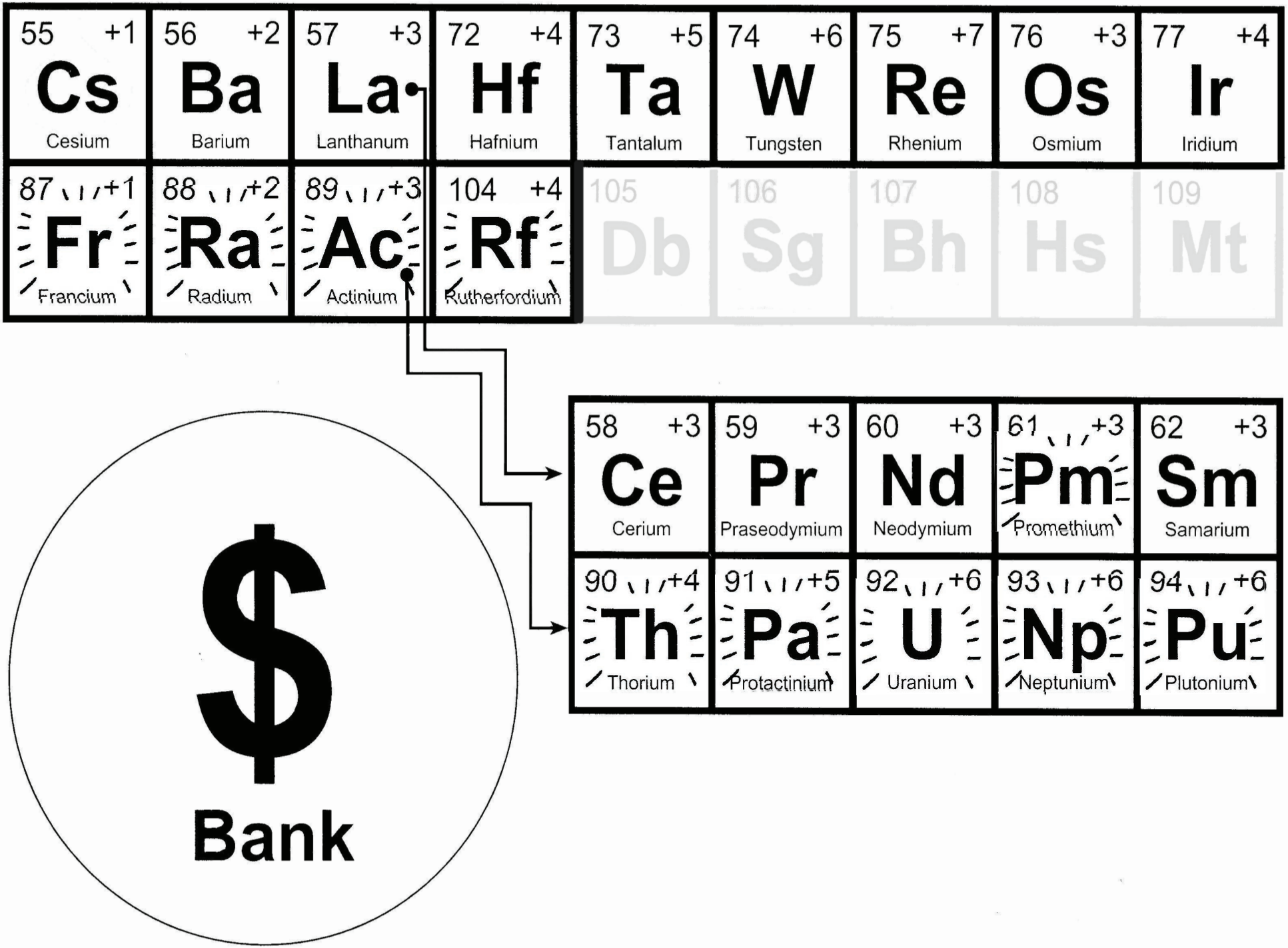
Named After Person or Place > **3 Extra Pennies if You Name It!**

1 +1 **H** Hydrogen								
3 +1 **Li** Lithium	4 +2 **Be** Beryllium							
11 +1 **Na** Sodium	12 +2 **Mg** Magnesium							
19 +1 **K** Potassium	20 +2 **Ca** Calcium	21 +3 **Sc** Scandium	22 +4 **Ti** Titanium	23 +5 **V** Vanadium	24 +6 **Cr** Chromium	25 +7 **Mn** Manganese	26 +3 **Fe** Iron	27 +3 **Co** Cobalt
37 +1 **Rb** Rubidium	38 +2 **Sr** Strontium	39 +3 **Y** Yttrium	40 +4 **Zr** Zirconium	41 +5 **Nb** Niobium	42 +6 **Mo** Molybdenum	43 +7 **Tc** Technetium	44 +3 **Ru** Ruthenium	45 +3 **Rh** Rhodium



Radioactive Shields

						2 0 **He** Helium
		5 +3 **B** Boron	6 +4 **C** Carbon	7 -3 **N** Nitrogen	8 -2 **O** Oxygen	9 -1 **F** Fluorine	10 0 **Ne** Neon
		13 +3 **Al** Aluminum	14 +4 **Si** Silicon	15 -3 **P** Phosphorus	16 -2 **S** Sulfur	17 -1 **Cl** Chlorine	18 0 **Ar** Argon
28 +3 **Ni** Nickel	29 +2 **Cu** Copper	30 +2 **Zn** Zinc	31 +3 **Ga** Gallium	32 +4 **Ge** Germanium	33 -3 **As** Arsenic	34 -2 **Se** Selenium	35 -1 **Br** Bromine	36 0 **Kr** Krypton
46 +4 **Pd** Palladium	47 +1 **Ag** Silver	48 +2 **Cd** Cadmium	49 +3 **In** Indium	50 +4 **Sn** Tin	51 -3 **Sb** Antimony	52 -2 **Te** Tellurium	53 -1 **I** Iodine	54 0 **Xe** Xenon


55 +1 Cs Cesium
56 +2 Ba Barium
57 +3 La Lanthanum
72 +4 Hf Hafnium
73 +5 Ta Tantalum
74 +6 W Tungsten
75 +7 Re Rhenium
76 +3 Os Osmium
77 +4 Ir Iridium
87 +1 Fr Francium
88 +2 Ra Radium
89 +3 Ac Actinium
104 +4 Rf Rutherfordium
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
58 +3 Ce Cerium
59 +3 Pr Praseodymium
60 +3 Nd Neodymium
61 +3 Pm Promethium
62 +3 Sm Samarium
90 +4 Th Thorium
91 +5 Pa Protactinium
92 +6 U Uranium
93 +6 Np Neptunium
94 +6 Pu Plutonium
$
Bank

78 +4	79 +3	80 +2	81 +3	82 +4	83 -3	84 -2	85 -1	86 0
Pt Platinum	**Au** Gold	**Hg** Mercury	**Tl** Thallium	**Pb** Lead	**Bi** Bismuth	**Po** Polonium	**At** Astatine	**Rn** Radon
110 **Ds**	111 **Rg**	112 **Cn**	113 **Nh**	114 **Fl**	115 **Mc**	116 **Lv**	117 **Ts**	118 **Og**

Go to 72 Hf

63 +3	64 +3	65 +3	66 +3	67 +3	68 +3	69 +3	70 +3	71 +3
Eu Europium	**Gd** Gadolinium	**Tb** Terbium	**Dy** Dysprosium	**Ho** Holmium	**Er** Erbium	**Tm** Thulium	**Yb** Ytterbium	**Lu** Lutetium
95 +6 **Am** Americium	96 +4 **Cm** Curium	97 +4 **Bk** Berkelium	98 +4 **Cf** Californium	99 +3 **Es** Einsteinium	100 +3 **Fm** Fermium	101 +3 **Md** Mendelevium	102 +3 **No** Nobelium	103 +3 **Lr** Lawrencium

Go to 104 Rf

Start

THE Periodic Table Game

Liquid or Gas at Room Temperature > **Roll Again**

Radioactive > **Put up Shields on Either Side** 

Named After Person or Place > **3 Extra Pennies if You Name It!**

1 +1 H Hydrogen									
3 +1 Li Lithium	4 +2 Be Beryllium								
11 +1 Na Sodium	12 +2 Mg Magnesium								
19 +1 K Potassium	20 +2 Ca Calcium	21 +3 Sc Scandium	22 +4 Ti Titanium	23 +5 V Vanadium	24 +6 Cr Chromium	25 +7 Mn Manganese	26 +3 Fe Iron	27 +3 Co Cobalt	
37 +1 Rb Rubidium	38 +2 Sr Strontium	39 +3 Y Yttrium	40 +4 Zr Zirconium	41 +5 Nb Niobium	42 +6 Mo Molybdenum	43 +7 Tc Technetium	44 +3 Ru Ruthenium	45 +3 Rh Rhodium	