Bay Area Scientists in Schools Presentation Plan

Lesson Name Matter: A Periodic Puzzle
Presenters Eric Selle, Vu Ngo

Grade Level 3 **Standards Connections** Using numerical/symbolic data (Periodic Table)

Teaser
This lesson introduces 3rd grade students to the super tiny building blocks that make up matter – atoms! After engaging students about their own ideas of what things are made of, they'll learn that even large objects are made of particles too small for the eye to see. Students will get to know the scale and structure of an atom (protons and electrons), how different kinds of atoms are called elements, the basics of how elements are organized into a periodic table, and how elements can combine to form molecules. Activities include a worksheet where students locate elements in the periodic table, a crossword puzzle (which they can take home), and assembling common molecules using multi-colored spheres and toothpicks. Students will also explore the phases matter can assume by way of demonstration with marbles in a shoebox.

Objective
To introduce students to the atomic theory of matter, and familiarize them with how the Periodic Table of Elements can be used to learn about different kinds of atoms.

Vocabulary/Definitions

Atom – the smallest part of an element

Proton – positively charged particle that's found in an atom's nucleus, or center.

Electron – negatively charged particle that orbits the nucleus.

Element – any of the more than 100 known substances that cannot be separated into simpler substances

Molecule – a collection of two or more atoms, either of single or multiple elements.

Periodic Table of Elements – table of elements arranged according to atomic number.

Materials
Print-outs of Periodic Table (30+)
Small colored spheres & toothpicks
Build-a-Word worksheets (30+)
Atomic Crossword Puzzles (30+)

Students should have pencils

Classroom Set-up
Students will work in groups of 3 to 4, assigned by a count-off. Set-up and clean-up should be less than 5 minutes each.

Classroom Visit

1. **Personal Introduction**
   My name is Eric and I am a student at Laney College in Oakland. I'd like to explore with you what I think is one of the most incredible subjects in science – atoms. When I first learned about atoms, it changed the way I looked at the world and the universe, and it still does today. What I'd like you all to take away from this is that everywhere you look there's much more than the eyes can see. Even the air you breathe is made up of many millions of atoms. And the amazing thing is that because of science we have the opportunity to know about this stuff even though we can't see it! **2-3 mins**

   Topic Introduction
   What's a pizza made of?

   Everything that takes up space, which we call matter, is made up of invisible pieces called atoms. These atoms cannot be created nor destroyed, they can only change states. Not like United States – the states we mean are liquid, solid, and gas. Atoms consist of a tiny nucleus, which is like the core of an apple, and even tinier electrons. To give an idea of how small an atom is, if we make a small dot with a pencil it will contain over 4 billion billion carbon atoms! (That's a 4 with 18 zeroes after it!) Now let's imagine the Oakland Coliseum and pretend that that is the whole atom. If the whole atom is the Coliseum, then the nucleus of that atom is the size of a football sitting in the middle of the field, and the electrons are like little fleas zooming all around. There are over 100 different kinds of atoms which we call elements, and each of them has a name, a symbol, and a number.

   Define terms. **10 mins**

2. **Learning Experiences**

Students will work in groups of 3 to 4, assigned by a count-off. Set-up and clean-up should be less than 5 minutes each. **2-3 mins**

After topic introduction, we'll pass out periodic tables and then review the components of an atom, relating them to what they see in the table (element name, symbol, and number).

On the board I'll draw the periodic entry for silver, for instance, and then diagram what the notation corresponds to: **5 mins**

silver – Name

Ag – Symbol, and point out that some have one letter, some have two, and when there are two letters the first is capital and the second is lower-case.

47 – Number of protons and electrons in a silver atom

108 - Number of protons + Number of Neutrons in a silver atom's nucleus

I'll ask students to find elements and say how many electrons they have, or give them a number of protons and find the element. (insert elements and #'s here.)
5 mins

Hand out Build-a-Word worksheets and let them work on them individually but encourage them to work together. **10-15 mins**

Transition into building molecules: On the board I'll write the chemical expression for water and explain what the notation means. Students will be given colored spheres (each color representing an element) and toothpicks, and then make molecules, writing down the chemical formulas for whatever they make. **10-15 mins**

Final demonstration relates to phases of matter, and consists of placing increasing numbers of marbles into a shoebox-sized clear container (the least for gas, most for solids). **5 mins**

3. **Wrap-up: Sharing Experiences**
   What did we learn today?

   Review atom components. Ask students (and have them all answer together if they want) to rank the components in increasing size.

   Review periodic table notation.

   Review phases of matter. **5 mins**

4. **Connections & Close**
   Impress upon them the most common elements they encounter (hydrogen, nitrogen, oxygen, carbon, calcium, silicon)

   Use example of a carbonated beverage (mixture of gas and liquid), and deflated sports ball (gas contracts when cooled, expands when hot) to relate chemistry to their everyday lives. Ask if anyone has ever accidentally left a can of soda in the freezer.

   5 mins

   Thanks and goodbye!

Follow-up – After Presentation

Students are encouraged to take home and complete their crossword puzzles.

Periodic Table of the Elements

Metals
Non-Metals
Noble Gases

Key:

element name atomic number **symbol** atomic weight

hydrogen 1 **H** 1.00794																	helium 2 **He** 4.002602
lithium 3 **Li** 6.941	beryllium 4 **Be** 9.012182											boron 5 **B** 10.811	carbon 6 **C** 12.0107	nitrogen 7 **N** 14.00674	oxygen 8 **O** 15.9994	fluorine 9 **F** 18.9984	neon 10 **Ne** 20.1797
sodium 11 **Na** 22.98977	magnesium 12 **Mg** 24.3050											aluminium 13 **Al** 26.981538	silicon 14 **Si** 28.0855	phosphorus 15 **P** 30.97376	sulphur 16 **S** 32.065	chlorine 17 **Cl** 35.453	argon 18 **Ar** 39.984
potassium 19 **K** 39.0983	calcium 20 **Ca** 40.078	scandium 21 **Sc** 44.95591	titanium 22 **Ti** 47.867	vanadium 23 **V** 50.9415	chromium 24 **Cr** 51.9961	manganese 25 **Mn** 54.93805	iron 26 **Fe** 55.845	cobalt 27 **Co** 58.9332	nickel 28 **Ni** 58.6934	copper 29 **Cu** 63.546	zinc 30 **Zn** 65.409	gallium 31 **Ga** 69.723	germanium 32 **Ge** 72.64	arsenic 33 **As** 74.9216	selenium 34 **Se** 78.96	bromine 35 **Br** 79.904	krypton 36 **Kr** 83.798
rubidium 37 **Rb** 85.4678	strontium 38 **Sr** 87.62	yttrium 39 **Y** 88.90585	zirconium 40 **Zr** 91.225	niobium 41 **Nb** 92.90638	molybdenum 42 **Mo** 95.94	technetium 43 **Tc** [98]	ruthenium 44 **Ru** 101.07	rhodium 45 **Rh** 102.9055	palladium 46 **Pd** 106.42	silver 47 **Ag** 107.8682	cadmium 48 **Cd** 112.411	indium 49 **In** 114.818	tin 50 **Sn** 118.710	antimony 51 **Sb** 121.760	tellurium 52 **Te** 127.60	iodine 53 **I** 126.9045	xenon 54 **Xe** 131.293
caesium 55 **Cs** 132.90545	barium 56 **Ba** 137.327	lutetium 71 **Lu** 174.967	hafnium 72 **Hf** 1.00794	tantalum 73 **Ta** 180.9479	tungsten 74 **W** 183.84	rhenium 75 **Re** 186.207	osmium 76 **Os** 190.23	iridium 77 **Ir** 192.217	platinum 78 **Pt** 195.078	gold 79 **Au** 196.96655	mercury 80 **Hg** 200.59	thallium 81 **Tl** 204.3833	lead 82 **Pb** 207.2	bismuth 83 **Bi** 208.980	polonium 84 **Po** [209]	astatine 85 **At** [210]	radon 86 **Rn** [222]
francium 87 **Fr** [223]	radium 88 **Ra** [226]	lawrencium 103 **Lr** [262]	rutherfordium 104 **Rf** [261]	dubnium 105 **Db** [262]	seaborgium 106 **Sg** [266]	bohrium 107 **Bh** [264]	hassium 108 **Hs** [269]	meitnerium 109 **Mt** [268]	darmstadtium 110 **Ds** [271]	roentgenium 111 **Rg** [272]	ununbium 112 **Uub** [285]		ununquadium 114 **Uuq** [289]				

lanthanum 57 **La** 138.9055	cerium 58 **Ce** 140.116	praseodymium 59 **Pr** 140.90765	neodymium 60 **Nd** 144.24	promethium 61 **Pm** [145]	samarium 62 **Sm** 150.36	europium 63 **Eu** 151.964	gadolinium 64 **Gd** 157.25	terbium 65 **Tb** 158.9253	dysprosium 66 **Dy** 162.50	holmium 67 **Ho** 164.930	erbium 68 **Er** 167.259	thulium 69 **Tm** 168.934	ytterbium 70 **Yb** 173.04
actinium 89 **Ac** [227]	thorium 90 **Th** 232.038	protactinium 91 **Pa** 231.0359	uranium 92 **U** 238.0289	neptunium 93 **Np** [237]	plutonium 94 **Pu** [244]	americium 95 **Am** [243]	curium 96 **Cm** [247]	berkelium 97 **Bk** [247]	californium 98 **Cf** [251]	einsteinium 99 **Es** [252]	fermium 100 **Fm** [257]	mendelevium 101 **Md** [258]	nobelium 102 **No** [259]

Notes: Elements with atomic weights in square brackets have no stable isotopes. Different sources list different atomic weights for elements. The difference arises from the differing atomic weights of various isotopes. We have tried to list the most stable isotope. For example, some sources list the atomic weight of seaborgium as 263 and others 266. The most stable isotope appears have an atomic weight of 266 so we list that weight here. Roentgenium is still the unofficial name of element 111 but it is the one recommended by the IUPAC so we list it here instead of the generic 'unununium'. Aluminum, cesium, and sulfur are the American spellings for aluminium, caesium, and sulphur.
This table was downloaded from http://www.science-teachers.com/printable_periodic_tables.htm.

SCIENCE STARS
GRADE 3

MATTER

BUILD A WORD

Directions: Find the symbol of each element on the Periodic Table of Elements and write it in the box to create a word.

1. [C] + [Ra] + [B] = Crab
   Carbon, Radium, Boron

2. [ ] + [ ] + [ ] + [ ] = _____
   Flourine (Fluorine), Iodine, Sulfur (Sulphur), Hydrogen

3. [ ] + [ ] = _____
   Selenium, Aluminum (Aluminium)

4. [ ] + [ ] = _____
   Chlorine, Americium

5. [ ] + [ ] + [ ] = _____
   Barium, Sulfur (Sulphur), Sulfur (Sulphur)

6. [ ] + [ ] + [ ] + [ ] = _____
   Tungsten, Aluminum (Aluminium), Ruthenium, Sulfur (Sulphur)

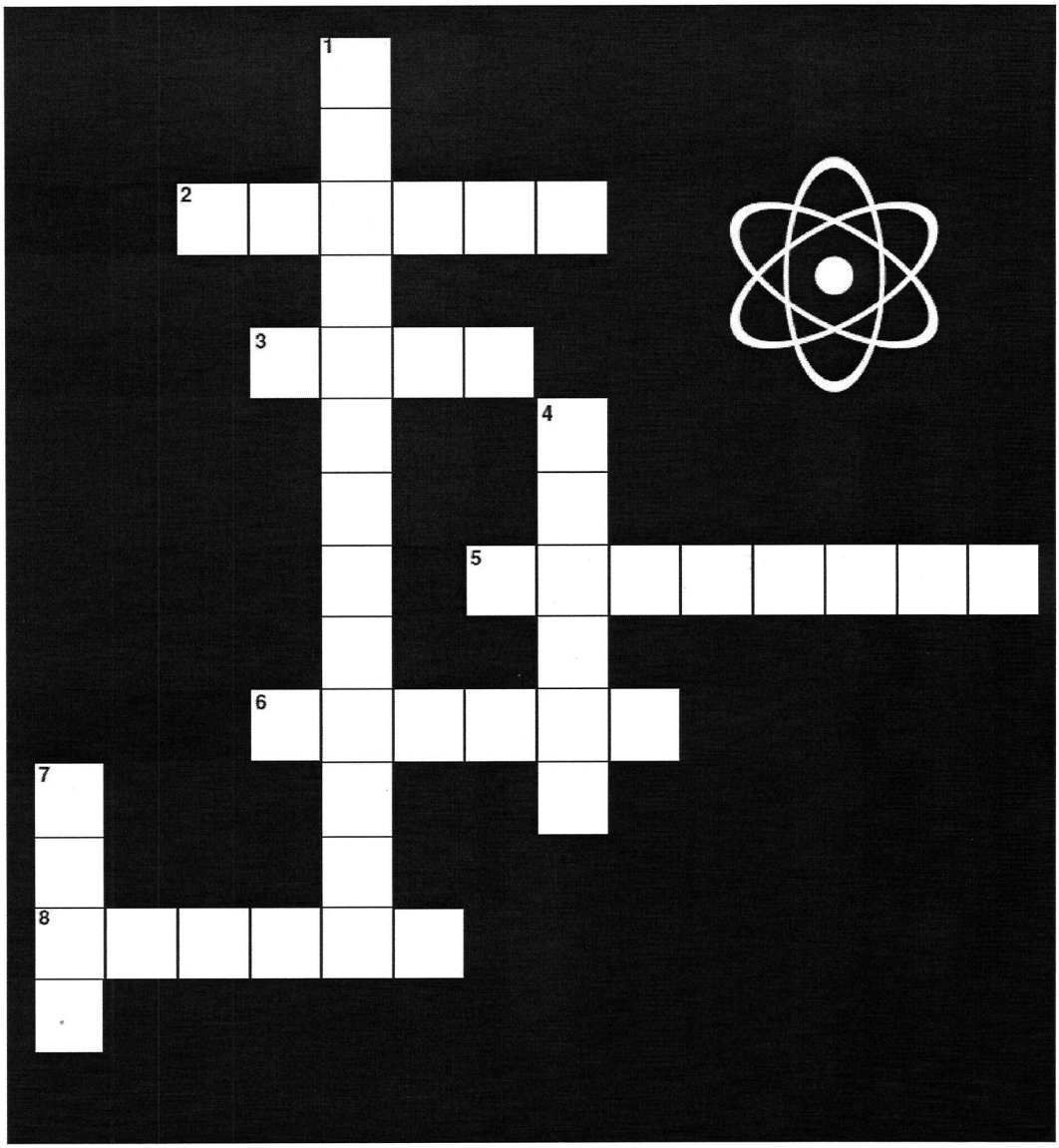
7. [ ] + [ ] + [ ] + [ ] + [ ] = _____
   Selenium, Aluminum (Aluminium), Iodine, Oxygen, Nitrogen

8. [ ] + [ ] + [ ] + [ ] + [ ] = _____
   Phosphorus, Uranium, Flourine (Fluorine), Flourine (Fluorine), Indium

MATTER WORKSHEET CROSSWORD PUZZLE

Directions: Use the words below to answer the questions and fill in the crossword puzzle.

ATOM
CARBON
ELEMENTS
GOLD
MATTER
OXYGEN
PERIODIC TABLE
SILVER



ACROSS:

2. Number 6 on the Periodic Table (C)
3. A valuable metal (first place in the Olympics)
5. Types of atoms
6. Anything that takes up space
8. The atoms we need to breathe (number 8)

DOWN:

1. A chart where all the types of atoms are listed
4. A valuable metal (second place in the Olympics)
7. The smallest piece of matter