Bay Area Scientists in Schools Presentation Plan

Lesson Name Elements of Life **Grade Level:** 5th
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CA Science Standards Connections: 5th Grade, Physical Science

5-PS-1) Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:

a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
b. Students know all matter is made of atoms, which may combine to form molecules.
d. Students know that each element is made of one kind of atom and that the elements are organized in the periodic table by their chemical properties.
e. Students know scientists have developed instruments that can create discrete images of atoms and molecules that show that the atoms and molecules often occur in well-ordered arrays.
g. Students know properties of solid, liquid, and gaseous substances, such as sugar (C6H12O6), water (H2O), helium (He), oxygen (O2), nitrogen (N2), and carbon dioxide (CO2).
h. Students know living organisms and most materials are composed of just a few elements.
i. Students know the common properties of salts, such as sodium chloride (NaCl).

Next Generation Science Standards:

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [
5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. (**5-PS1-1**) *Planning and Carrying Out Investigations* Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (**5-PS1-4**) Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (**5-PS1-3**)	*PS1.A: Structure and Properties of Matter* Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects. (**5-PS1-1**) The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (**5-PS1-2**) Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (**5-PS1-3**) *PS1.B: Chemical* Reactions When two or more different substances are mixed, a new substance with different properties may be formed. **(5-PS1-4)** No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (**5-PS1-2**)	*Cause and Effect* Cause and effect relationships are routinely identified, tested, and used to explain change. (**5-PS1-4**) *Connections to Nature of Science* Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems. (**5-PS1-2**)

Common Core Standards:

ELA/Literacy:

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Mathematics:

MP.2 Reason abstractly and quantitatively.

MP.5 Use appropriate tools strategically.

MP.4 Model with mathematics.

FOSS Connections:

Grade 5 Module: *Mixtures and Solutions*

Vocabulary Definitions:

- **element**: substances that consist of atoms of only one kind
- **compound**: substances that consist of atoms of different kind
- **atom**: smallest whole particle of an element
- **metal**: elements that are typically opaque, fusible, ductile, often lustrous, good conductors of electricity and heat
- **non-metal**: elements that are typically brittle, not lustrous, poor conductors of electricity and heat
- **salt**: compound of metal + non-metal, distinct crystal structures, dissolve to create solutions that conduct electricity.
- **periodic table**: list of all known elements grouped by common properties

Materials

What will you bring with you?

- Periodic table (40cm X 28 cm)
- dry erase marker and eraser
- vitamin bottle
- large butcher paper for human silhouette
- colored pens
- Chemistry Demo consists of
    - Plexiglas isolation chamber
    - charcoal brickette
    - beaker
    - sugar
    - gloves
    - eye protection
    - concentrated battery acid (in safety container), and
    - baking soda (for acid neutralization).
- Element cards for game.

Classroom Set Up:

- Way to display periodic table for entire class to see, e.g. an easel or bulletin board.
- Chalkboard or dry erase board at front of room.
- Table or work area at front of room.
- Colored markers, pens, or crayons
- Some activities work best in small groups

Classroom Visit

1. **Personal Introduction**:

What do you do for work, hobbies, play? Why are you interested in this topic?

Today we're going to be thinking about the different elements that make up everything around us. I am a scientist at Children's Hospital & Research Center at Oakland. I am interested in nutrition, especially vitamins & minerals – all of which are made of elements. I study what happens when people don't get enough of the elements that their bodies need.
I was interested in science early – enjoyed microscope kit as a toy; pretended to be detective.
I enjoyed science classes and loved to ask the question "why" – science is all about this question.
I started in nutrition because I learned that iron – a metal - can be good and bad for you – that didn't make sense. Studying iron also gave me an appreciation for all of the other elements we need for our nutrition. Amazingly, we STILL don't know exactly how much of some of the elements we need and what the elements do inside our body!

Building Connections to Kids' Experiences: Can you think of an experience most kids would have related to your topic? Is there something to show that will grab their attention? Or can you pose a mystery with a question about something they see everyday?

Does anyone know any names of some elements? [Circle on Periodic Table as named] Where can we find these elements? Does anyone know what elements are found in water? Does anyone know what elements are found in the air we breathe? Can anyone name some other elements found in this room right now?

There are over 100 known elements (112 so far!), although only 83 of those occur naturally. The rest are man-made. All the elements we know are on this Periodic Table. So how do such a small number of elements make up all the different matter in the universe? Lets find out.

2. **Learning Experiences**

Any combination of demonstrations, hands-on activities, and pictures that helps kids explore new ideas.
Describe specific experiences in the order you plan, including instructions you need to give students.

Activity 1: How can small numbers of elements make up very different matter? Pass out gumdrops of 2 different colors and toothpicks to students. Explain that the 2 different colored gumballs represent 2 different elements – sodium and chlorine. Show model of salt molecules and draw chart on board showing properties of sodium and chlorine - sodium by itself will

explode when it touches anything wet and chlorine by itself is an extremely toxic gas. Then show 3-dimensional model of how sodium likes to "bond" to chlorine in cubic structure. Ask students to use toothpicks for bonds and to make a model of the salt crystal. Then finish chart on board showing the properties of salt. Concept: Elements can form compounds by bonding together; these compounds can have very different properties from the original elements. This is how the elements can make up everything we know. Just like 26 letters can be combined into all the words in the dictionary, the elements can be combined in different kinds of molecules.

Activity 2: So once elements join to form new compounds, are they changed forever or are original elements still there? Let's see if we can break a compound back down to it's original elements. Inside a protective clear Plexiglas chamber, place beaker of sugar. Explain sugar [show sugar] contains carbon, hydrogen, and oxygen mixed together – but it doesn't look like charcoal [show charcoal], so is the carbon really still there? Let's do an experiment to find out. We know that with enough chemical energy, we can "pull" hydrogens and oxygens away from compounds as water. So, car battery acid [note that this is very dangerous], might be able to. Add strong battery acid to the sugar in protective chamber and mix. While waiting 1-2 minutes, for reaction, draw elements and compound on board. During that time, a "black snake" will appear to grow from inside the beaker and a funny smell will be in the air. What is going on and what is the black material? Make predictions based on elemental description. Concept: Compounds may have very different properties, but the constitutive elements are still there. Just like you can take all of the words in the dictionary and divide them into the 26 known letters.

Nutrition: Our bodies are made of lots of different elements in different compounds, but some elements are more common than others. If I tell you that the body is about 70% water, can anyone figure out what the two most common elements in our bodies are? [Prompt answer with H2O if necessary.] How many other elements would you guess can be found inside of us? [Write down guesses on board and then circle correct answer.]

Do you know many elements that are good for your body? Does anyone know what important element is found in milk and cheese that is good for our bones? [Prompt for calcium.] Does anyone know what important element is found in meat and some veggies like spinach that is good for our blood? [Prompt for iron.] How many of you take vitamins? Let's look at the elements that are in a typical vitamin. [Show vitamin bottle and read back – write elements on board and mention what they do in body- help muscles work, etc.]

Good nutrition is really about getting the right amounts of the right kinds of elements in our food. Some people take vitamins to get elements they might not be getting in their meals. But you can also get too much of something as well as too little. So paying attention to what you eat is important. Since we're made of lots of different elements, let's look at the most common elements in our body by drawing a picture.

Activity 3: What elements are people made of? Divide students into groups and trace the outline of volunteer students onto butcher paper. On the board, list chart of what elements are inside people at what percent. Ask students to color in this percentage onto their paper model of a person in the correct proportions. (Tests some basic math principles) With that chart, answer questions: What is the most common element? What is the most common metal? What

are some of the least common elements? Concept: Many elements make up a person, but the four most abundant are hydrogen, carbon, oxygen, and nitrogen.

Activity 4: [Optional if time allows] What elements are some other things made of? Display a large periodic table and review some of the basics of the table, like light to heavy elements, solid-liquid-gas elements, stable-radioactive elements, etc. Then give student volunteer a card with picture of a common items and have student read identity statements, like "I am a light metal," "I am a gas commonly found in air", "I am a common element in teeth and bone," etc. Ask other students to guess the element after giving clues with increasing easiness. Use dry erase marker to cross out correctly identified elements on periodic table. Concept: Everything is made from the elements of the periodic table; many common items contain interesting or unusual elements.

3. **Wrap-up: Sharing Experiences and Building Connections**
How kids will share experiences and build links to ideas and vocabulary.

Sharing and Interpretation: Ideas for questions to invite sharing and guide interpretation of experiences.

How can some elements be bad for us (like sodium & chlorine) but their compounds (like salt) be good? [When they combine, their properties change.]

Why is nutrition important? [It helps us get the elements we need to live and grow.]

If elements make a compound (like sugar), are the elements still there? How do we know? [Yes because they can be broken down into their elements.]

What are some of the most common elements inside us? [H, O, C, N]

What do some of the elements do inside our bodies? [varied tasks, list on board as described]

What element(s) were you surprised to find in an everyday item?

4. **Closing Statements**: connect experiences to larger world, big ideas, vocabulary.
Three take-home messages:
1: "The periodic table is the playbook for the whole universe." Everything that we can see and feel is made from the elements on the periodic table, this includes the sun, the air, the oceans, the school, the desks, and everyone in this room.
2: "You can't judge an elemental book by its cover." Some elements can look and act very different based on natural form. For example, charcoal, pencil "lead", and diamonds are all made out of exactly the same thing (carbon), but the forms are different. Also, when elements combine, their compounds can have radically different properties. Table salt is needed for our proper nutrition, but component elements are very toxic.
3: "The dose makes the poison." Too much or too little of any of the needed elements can cause diseases. For example, you have to have water and salt everyday or you will get sick; however, you can also get very sick of more than a gallon of water or 2 tablespoons of table

salt. It is critical to have the right "elemental balance". Nutrition is really just making sure that our body gets the right balance of elements from the periodic table.

Restate why I like studying the science of nutrition and point out that there are many mysteries not yet figured out that future scientists will need to help us with.

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and orally narrate demonstrations. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students write hypotheses about the functions of each element in the body.

Follow-up Possibilities

ELA Activity:

1. Write a letter about what the students learned - include drawings of an item containing an element or an experiment that we did together.

2. Write a report on your favorite element. Identify the properties of the element, like metal vs. non-metal, solid vs. liquid vs. gas, stable vs. radioactive, abundant vs. rare, light vs. heavy, etc. What is the normal color? Where is the element found in nature? What everyday items is this element used in?

3. Write a report on an element needed for human nutrition. How much is in a healthy person? What happens if you don't get enough of it? What happens if you get too much? What foods is it found in?

Mathematics Activity:

Have students convent the percentages of elements in different compounds into fractions. Students can also convert the percentages of body elements into fractions and vice versa.

Other:

Recommended web site: http://www.webelements.com. See attached supplemental material.