

Some Background Concerning Physical Science Content Standards for Fifth-Grade Teachers: Atoms in Living Organisms

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Introduction

The background information for teachers in this document addresses the following physical science content standards¹ for fifth-grade teachers:

- 1. Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:
h. Students know living organisms and most materials are composed of just a few elements.***

¹ As specified in *Science Framework for California Public Schools Kindergarten Through Grade Twelve*. Sacramento: California Department of Education, 2003, p 69.

Physical Science Topic: Atoms in Living Organisms

Science Framework² for California Public Schools

Grade 5: Standard Set 1. Physical Sciences: 1.h. *"Students know living organisms and most materials are composed of just a few elements."*

"By weight 98.59 percent of Earth's entire crust consists of eight elements: oxygen, silicon, aluminum, iron, calcium, sodium, potassium, and magnesium. Nearly 3,500 known minerals are in Earth's crust. This fact shows that the complexity of the crust is also the result of a small number of elements in a large variety of combinations. Similarly, living organisms are mostly composed of the elements carbon, oxygen, hydrogen, nitrogen, sulfur, and phosphorus. The number of types of atoms used as "building blocks" is relatively small. The way in which the atoms are organized into molecules provides variety."

Background for Teachers

Matter (solid, liquid, gas) is made of atoms and molecules. We have over 100 kinds of atoms (elements) here on Earth. Every kind of atom on our planet is listed in the *Periodic Table of the Elements* (Figure 1).

Although we have over 100 kinds of atoms, most of the Earth's crust is composed of only eight kinds of atoms. These common atoms combine in many ways to form thousands of kinds of mineral molecules – one of the most common of which is silicon dioxide (glass and quartz).

² As specified in *Science Framework for California Public Schools Kindergarten Through Grade Twelve*. Sacramento: California Department of Education, 2003, p. 62.

H																	He																														
Li	Be											B	C	N	O	F	Ne																														
Na	Mg											Al	Si	P	S	Cl	Ar																														
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																														
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																														
Cs	Ba		Hf	Ta	H	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																														
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>= 0	> 34	> 69	> 103	> 138	> 172	> 206	> 241																																								

Figure 1. Periodic Table³ of the Elements (Atoms). This table lists every type of atom that exists on Earth. Smaller, lighter atoms are listed at the top of the table (hydrogen is the smallest, lightest atom); larger, heavier atoms are listed at the bottom of the table. Most molecules in living organisms are made out of only six kinds of atoms, which are relatively small and light: carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulfur (S), and phosphorus (P).

Atoms in Living Organisms

Living organisms are composed of molecules that contain atoms from rocks, air, and water. Most of the molecules in living organisms are made out of only six kinds of atoms, which are relatively small and light: carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulfur (S), and phosphorus (P).

Plants bring atoms into the food chains of ecosystems by absorbing molecules from rocks, air, and water. The planetary sources of the most common atoms in our ecosystem are listed on the following page.

³ Image from website: http://upload.wikimedia.org/wikipedia/commons/e/ed/Atom_

Atoms from Rocks

- ♦ Sulfur atoms come from rocks; plant roots absorb sulfur atoms as mineral-nutrients⁴ from the soil.
- ♦ Phosphorus atoms come from rocks; plant roots absorb phosphorus atoms as mineral-nutrients⁵ from the soil.

Atoms from Air

- ♦ Nitrogen atoms come from the air; special bacteria absorb nitrogen atoms as molecules from the air, and release mineral-nutrients⁶ into the soil; plant roots then absorb nitrogen atoms as mineral-nutrients⁷ from the soil.
- ♦ Carbon atoms come from the air (they were released from volcanoes⁸ as carbon dioxide); plant leaves absorb carbon atoms as carbon dioxide molecules from the air.

Atoms from Water

- ♦ Hydrogen atoms come from water molecules (water comes from the ocean to the land and back again in the water cycle); plant roots absorb hydrogen atoms as water molecules in the soil.
- ♦ Oxygen atoms come from water (water comes from the ocean to the land and back again in the water cycle); plant roots absorb oxygen atoms as water molecules in the soil.

Molecules in living organisms break apart and reform as they travel through the food chains of ecosystems; however, the atoms themselves are never broken.

Atoms are re-used over and over again!

⁴ Sulfate molecules

⁵ Phosphate molecules

⁶ Nitrate and/or ammonia molecules

⁷ Nitrate and/or ammonia molecules

⁸ Pure carbon from rocks is found deep in the Earth's mantle, sometimes as diamonds

Websites

Youtube video and slide show of a song by a Harvard professor about every kind atom on the planet:

<http://www.youtube.com/watch?v=DYW50F42ss8>

Interactive website for students that describes each element in the periodic table:

http://www.eia.doe.gov/kids/energy.cfm?page=periodic_table

A great chemistry site for kids:

http://www.chem4kids.com/files/elem_intro.html