

## Average Chemical Composition of Earth's Crust, Hydrosphere, and Troposphere

ELEMENT (symbol)	CRUST		HYDROSPHERE	TROPOSPHERE
	Percent by mass	Percent by volume	Percent by volume	Percent by volume
Oxygen (O)	46.10	94.04	33.0	21.0
Silicon (Si)	28.20	0.88		
Aluminum (Al)	8.23	0.48		
Iron (Fe)	5.63	0.49		
Calcium (Ca)	4.15	1.18		
Sodium (Na)	2.36	1.11		
Magnesium (Mg)	2.33	0.33		
Potassium (K)	2.09	1.42		
Nitrogen (N)				78.0
Hydrogen (H)			66.0	
Other	0.91	0.07	1.0	1.0

### Overview:

Take a breath of air and 99% of it is composed of nitrogen and oxygen. Dive into a lake and you have slid by billions of water molecules consisting of two parts hydrogen and one part oxygen ( $H_2O$ ). But take a shovel full of dirt, part of the Earth's crust, and you are holding hundreds of different compounds chemically made from the combination of less than ten elements. Surprisingly, the crust's most abundant element is oxygen and it readily combines with the Earth's crust second most abundant element silicon, producing the compound silicone dioxide ( $SiO_2$ ), which is the mineral quartz. Other elements, pure or chemically combined, produce the minerals that make up the crust. Without these minerals, our planet would not be able to sustain life.

### The Chart:

The crust or lithosphere is the only sphere that is divided into a mass and volume column. Oxygen has the greatest percentage in both mass and volume. Notice that the chart shows that eight elements make up over 99% of the total mass and volume of the crust. The hydrosphere, representing the water sphere, consists of 33% oxygen and 66% hydrogen, chemically combined to form the molecule  $H_2O$ . The troposphere is the first layer of our atmosphere (see the Selected Properties of Earth's Atmosphere chart). This is the layer we live in and contains over 90% of all the gases of the total atmosphere, almost all of it being nitrogen and oxygen.

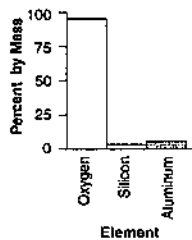
### Additional Information:

- $SiO_2$  is the composition for quartz, which is the main component of sand. It is used in the production of glass, jewelry and in electronic components. (See Quartz in the Properties of Common Minerals chart.)
- The other 1% of gases in the troposphere are mostly: water vapor, argon, and carbon dioxide.

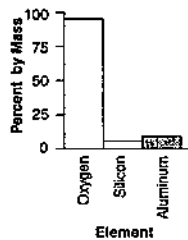
## Average Chemical Composition

### — Set 1 —

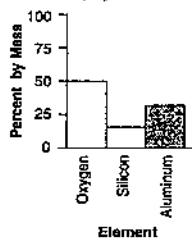
1. Earth's hydrosphere is best described as the
  - (1) solid outer layer of Earth
  - (2) liquid outer layer of Earth
  - (3) magma layer located below Earth's stiffer mantle
  - (4) gaseous layer extending several hundred kilometers from Earth into space1 \_\_\_\_\_
  
2. What are the two most abundant elements by mass found in Earth's crust?
  - (1) aluminum and iron
  - (2) sodium and chlorine
  - (3) calcium and carbon
  - (4) oxygen and silicon2 \_\_\_\_\_
  
3. Earth's troposphere, hydrosphere, and lithosphere contain relatively large amounts of which element?
  - (1) iron
  - (2) oxygen
  - (3) hydrogen
  - (4) potassium3 \_\_\_\_\_
  
4. Which graph correctly represents the 3 most abundant elements, by mass, in Earth's crust?



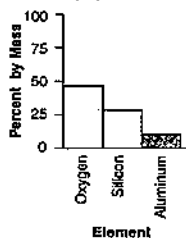
(1)



(2)



(3)



(4)

4 \_\_\_\_\_

### — Set 2 —

5. The most abundant element by volume in the hydrosphere is
  - (1) potassium
  - (2) hydrogen
  - (3) nitrogen
  - (4) silicon5 \_\_\_\_\_
  
6. Which metal is most abundant in the lithosphere?
  - (1) iron
  - (2) aluminum
  - (3) magnesium
  - (4) copper6 \_\_\_\_\_
  
7. In which sphere would one find more total oxygen by volume?
  - (1) the lithosphere
  - (2) the atmosphere
  - (3) the hydrosphere
  - (4) the mesosphere7 \_\_\_\_\_
  
8. Which two elements would equal almost 75% of the total mass of the lithosphere?
  - (1) O and Si
  - (2) O and Al
  - (3) Si and Al
  - (4) Si and Fe8 \_\_\_\_\_

9. Which sphere would be the densest?
- \_\_\_\_\_

10. Which sphere would be the least dense?
- \_\_\_\_\_