

Exercise 2 (Modules 2.2 – 2.3)Web/CD Activity 2A *The Levels of Life Card Game*Web/CD Thinking as a Scientist *Connection: How Are Space Rocks Analyzed for Signs of Life?*

Write the chemical symbol for each of the following elements, and state whether it is one of the four elements used by living things in large amounts (L), whether it is used in moderate amounts (M), or whether it is a trace element (T) required in small amounts.

<i>Symbol</i>	<i>Amount</i>	<i>Element</i>	<i>Symbol</i>	<i>Amount</i>	<i>Element</i>
		1. Magnesium			7. Carbon
		2. Oxygen			8. Calcium
		3. Zinc			9. Phosphorus
		4. Hydrogen			10. Nitrogen
		5. Copper			11. Sodium
		6. Iodine			12. Iron

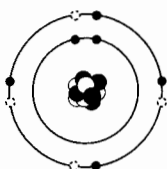
Exercise 3 (Modules 2.1 – 2.3)Web/CD Activity 2A *The Levels of Life Card Game*Web/CD Thinking as a Scientist *Connection: How Are Space Rocks Analyzed for Signs of Life?*

A compound is a substance that contains two or more elements in a fixed ratio. Indicate with a check mark which of the following are elements and which are compounds. (You may have to guess on some!)

	<i>Element</i>	<i>Compound</i>
1. Table salt		
2. Calcium		
3. Water (H ₂ O)		
4. Vitamin A		
5. Carbon		
6. Sulfur		
7. Carbon dioxide (CO ₂)		
8. DNA		
9. Iodine		
10. Protein		

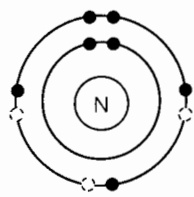
Exercise 4 (Modules 2.4 – 2.6)Web/CD Activity 2B *Structure of the Atomic Nucleus*Web/CD Activity 2C *Electron Arrangement*Web/CD Activity 2D *Build an Atom*

These modules introduce atoms. It is most important to know what the subatomic particles are, where they are located in an atom, and that atoms of different elements differ because they contain different numbers of protons. Some atoms not covered in these modules are compared below. You can figure out the subatomic particles they contain based on the concepts in the modules. First, fill in the blanks. Then sketch each atom, labeling and coloring **protons** red, **neutrons** gray, and **electrons** blue.

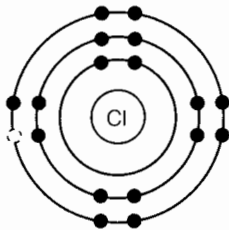
<i>Element</i>	<i>Symbol</i>	<i>Atomic Number</i>	<i>Mass Number</i>	<i>Number of Protons</i>	<i>Number of Neutrons</i>	<i>Number of Electrons</i>
1. Carbon-12	C	6	12	6	6	6
						
2. Nitrogen-14	___	7	14	___	___	___
3. Chlorine-35	___	___	35	17	___	___
4. Oxygen-16	___	___	___	___	___	8
5. Oxygen-17	___	___	___	___	___	___

Exercise 5 (Modules 2.7 – 2.8)Web/CD Activity 2E *Ionic Bonds*Web/CD Activity 2F *Covalent Bonds*

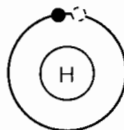
The atoms of four elements important to life are diagrammed below. Pay particular attention to their electron shells. Remember that atoms with incomplete outer electron shells participate in chemical reactions that allow them to attain complete outer shells: 2 electrons for a hydrogen atom, 8 electrons for most other elements important to life.



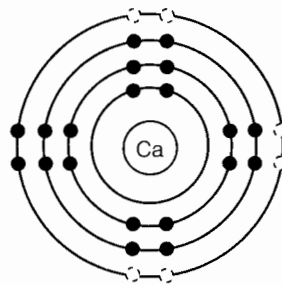
NITROGEN (N)
Atomic number = 7



CHLORINE (Cl)
Atomic number = 17



HYDROGEN (H)
Atomic number = 1



CALCIUM (Ca)
Atomic number = 20

- Given the information and diagrams above, show how electrons would be transferred between calcium and chlorine atoms to form calcium and chloride ions, which would then attract each other to form calcium chloride, CaCl_2 . (Hint: An atom can gain or lose more than one electron.)

- Using the information and diagrams above, show how nitrogen could form covalent bonds with several hydrogen atoms, forming a molecule of ammonia. What would be the molecular formula for ammonia?

Exercise 6 (Modules 2.9 – 2.14)

Web/CD Activity 2G *Nonpolar and Polar Molecules*

Web/CD Activity 2H *Water's Polarity and Hydrogen Bonding*

Web/CD Activity 2I *Cohesion of Water*

Review the properties of water by filling in the blanks in the following story.

When Amy came through the door, she found Liz poised over a glass of water, ready to drop a needle into the glass. Amy asked, "Liz, what are you trying to do?"

"We're studying the ¹ _____ basis of life in my biology class," Liz replied. "I don't believe some of this stuff she's teaching us, so I need to do some experiments to figure it out."

Liz gently placed the needle on the water surface. "Watch this," she said. The needle rested in a dimple on the surface of the liquid.

"How did you do that?"

"I didn't. The water did. Water molecules have a tendency to stick together, which is called ² _____. The water molecules are stuck together so tightly at the surface that they form a film that can support the weight of the needle. Bugs can walk on it. It's called ³ _____."

Amy was getting interested. She asked, "So how do the water molecules do it? What's so special about water?"

Liz explained, "A water molecule is H₂O, right? It is made up of one ⁴ _____ atom and two ⁵ _____ atoms. The atoms stay together because they ⁶ _____ electrons. This holds them together. A shared pair of electrons forms a chemical bond called a ⁷ _____ bond between each hydrogen atom and the oxygen atom. Now, if the electrons were shared evenly, the bond would be called a ⁸ _____ covalent bond. But they are not shared evenly. The oxygen tends to 'hog' the electrons away from the hydrogens. It has a greater attraction for electrons; it is more ⁹ _____ than hydrogen."

"So what does this have to do with floating needles?"

"Well, because the oxygen atom attracts the electrons more strongly, the shared electrons are closer to the oxygen than to the hydrogens, giving the oxygen a slight ¹⁰ _____ charge. Because the electrons are pulled away from the protons in the nuclei of the hydrogen atoms, the hydrogens are left with slight ¹¹ _____ charges. So the bonding electrons are shared unevenly, producing a ¹² _____ covalent bond between each hydrogen atom and the oxygen atom. In fact, the whole water molecule is polar, even though the molecule as a whole is electrically ¹³ _____."

Amy was getting impatient. "So what does that have to do with surface tension? And what's the biology connection?"

Liz went on, "Well, it is their polarity that causes water molecules to stick together. The ¹⁴ _____ charged oxygen of one water molecule is attracted to the ¹⁵ _____ charged hydrogens of other water molecules. These special

bonds between water molecules are called ¹⁶ _____ bonds. These bonds form a network at the water's surface, creating surface tension strong enough to support the needle. Each water molecule can connect with ¹⁷ _____ others. Hydrogen bonds are weak, but important. For example, they are responsible for holding the two strands of a ¹⁸ _____ molecule together, and for keeping ¹⁹ _____ molecules folded.

Hydrogen bonds give water some peculiar properties. For example, water is the only common substance on earth that naturally exists in all three states of matter—²⁰ _____, ²¹ _____, and ²² _____. And lots of things will dissolve in water; it is a versatile ²³ _____. Blood plasma, for example, is an ²⁴ _____ solution containing many different ²⁵ _____, or dissolved substances, such as salt and blood sugar."

Amy got up and opened the bathroom door, looked inside, and said, "It's steamy in there. Are you going to take a bath?"

Liz replied, "No, that's just another experiment. I'm trying to figure out the difference between heat and temperature."

"Are they different?"

"Yes. ²⁶ _____ is the total amount of energy resulting from the movement of molecules in a body of matter, like a bathtub full of water. ²⁷ _____ measures the intensity of movement. I compared the amount of heat in a cup of water at 98°C and a bathtub of water at 45°C. In the ²⁸ _____, the intensity of movement of water molecules was greater, but the ²⁹ _____ held more heat energy. I knew it did because the bathtub of water added more heat to the room as it cooled, warming up the room more than the cup of hot water did.

"Water has a great capacity to store heat, by the way. When water is heated, a lot of the energy goes into breaking the ³⁰ _____ between water molecules before the molecules can move faster. For instance, if you had a kilogram of water and a kilogram of rock, the same amount of heat would raise the temperature of the water ³¹ _____ than the temperature of the rock. This means water can soak up a lot of heat, and its temperature will go up only a few degrees."

"And when water cools a few degrees, it ³² _____ a lot of heat."

"Correct. And since animals are mostly water, this helps us control our body temperature. It also stabilizes the temperatures of the ocean and coastal areas. In the summer, the ocean ³³ _____ heat, and in the winter, it ³⁴ _____ heat."

Amy's eyes narrowed. "So why do we sweat when we are hot? Wouldn't we want to hang onto all that good water?"

Liz was ready with an answer. "No, not necessarily. Because of their strong hydrogen bonds, it takes a lot of heat energy to get a water molecule moving ³⁵ _____ enough to ³⁶ _____, to separate from its neighbors. This gives water an unusually high ³⁷ _____, but it also makes ³⁸ _____ cooling possible. The hottest—or fastest moving—water molecules evaporate first, taking a lot of heat energy with them and leaving the cooler—slower—molecules behind. So sweating cools you off on a hot day."

Exercise 9 (Summary)

Review basic chemical terminology by completing this crossword puzzle.

Across

2. ___ is the energy due to movement of molecules in a body of matter.

5. An ___ is a sub-atomic particle that circles an atom's nucleus.

7. The smallest particle of an element is called an ___.

9. An ___ is a charged atom or molecule.

12. Acid ___ is caused by pollutants that combine with water in the air.

16. ___ is anything that occupies space and has mass.

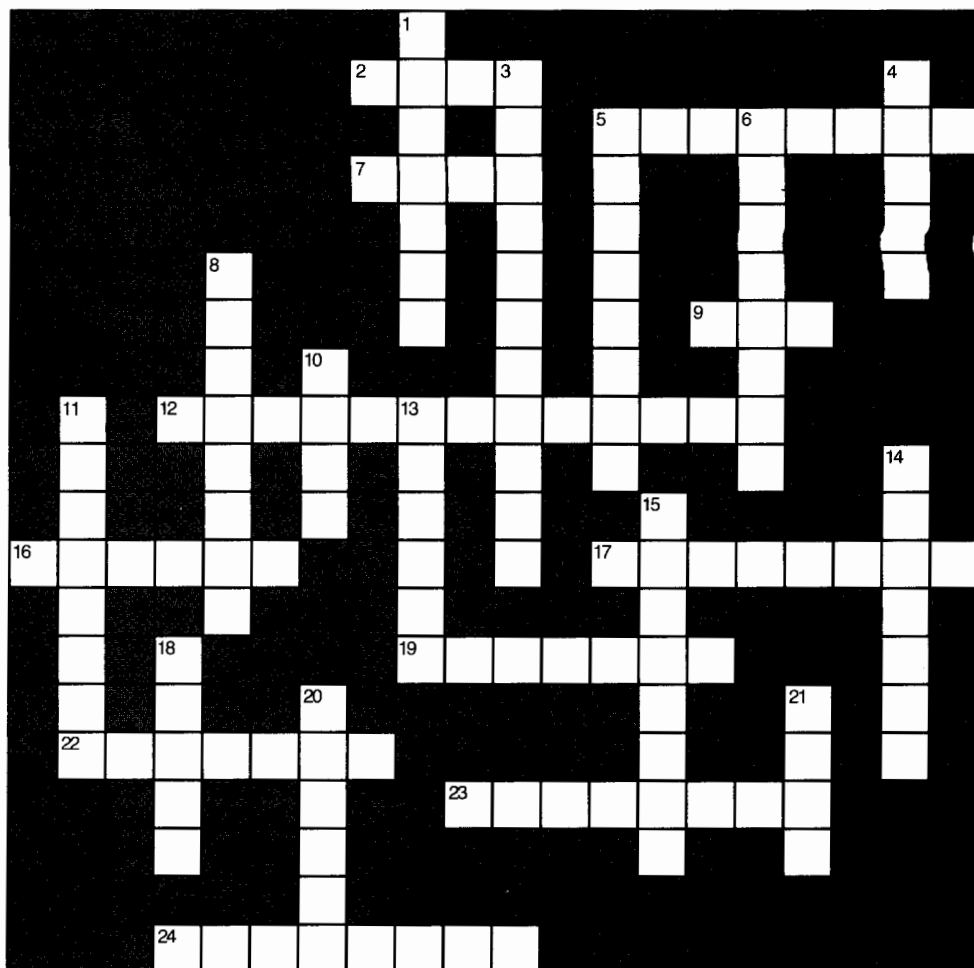
17. Two or more atoms held together by covalent bonds form a ___.

19. Neutrons and protons are found in an atom's ___.

22. The cohesion of water molecules is responsible for surface ___.

23. Variant forms of an element with different numbers of neutrons are called ___.

24. ___ is the tendency of water molecules to stick together.

**Down**

1. A ___ is a subatomic particle with no electrical charge.

3. ___ measures the intensity of heat.

4. Electrons are shared unequally in a ___ covalent bond.

5. There are 92 naturally occurring ___.

6. A ___ contains two or more elements in a fixed ratio.

8. Weak bonds between water molecules are called ___ bonds.

10. An ___ donates H^+ ions to solutions.

11. A ___ bond is formed when two atoms share electrons.

13. A ___ is a positively charged particle from the nucleus of an atom.

14. In a solution, the dissolving agent is called the ___.

15. A ___ is a liquid containing a uniform mixture of substances.

18. When two ions of opposite charges attract each other, an ___ bond forms.

20. The ___ is the substance dissolved in a solution.

21. A ___ accepts H^+ ions and removes them from solution.