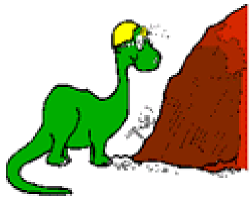
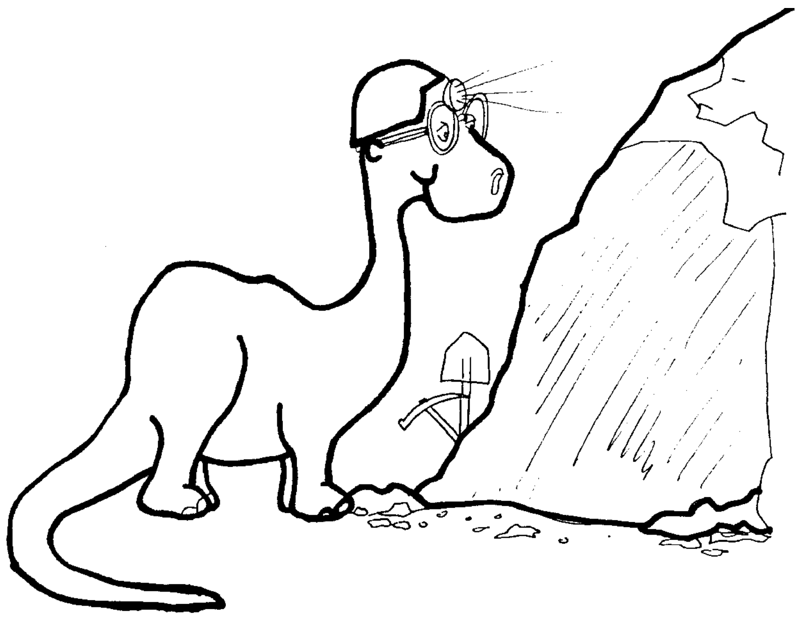


# Rock Cycle

## Understanding the Earth's Crust

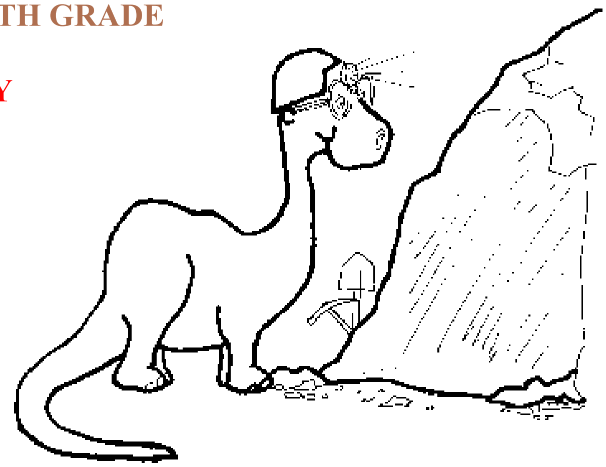
# FOURTH GRADE

# CHEMISTRY



1 WEEK
LESSON PLANS AND
ACTIVITIES

## ROCK CYCLE
## OVERVIEW OF FOURTH GRADE



### CHEMISTRY

**WEEK 1.**
PRE: *Analyzing the structure of the elements.*
LAB: *Investigating the chemical bonding of salt.*
POST: *Exploring the historical uses of salt.*

### MINERALS

**WEEK 2.**
PRE: *Observing and describing key characteristics.*
LAB: *Exploring the characteristics of minerals.*
POST: *Comparing and contrasting mineral properties.*

**WEEK 3.**
PRE: *Exploring the different shapes of minerals.*
LAB: *Analyzing mineral shapes.*
POST: *Examining minerals that are gemstones.*

### ROCKS

**WEEK 4.**
PRE: *Developing criteria to distinguish rocks.*
LAB: *Analyzing how different types of rocks are formed.*
POST: *Exploring the uses of rocks in the Indian culture.*

**WEEK 5.**
PRE: *Exploring parts of the rock cycle.*
LAB: *Analyzing and interpreting the shape of sand particles.*
POST: *Developing a story about rocks.*

### PAST LIFE

**WEEK 6.**
PRE: *Reconstructing fossil organisms.*
LAB: *Discovering that "the present is the key to the past."*
POST: *Recognizing fossil bones.*

**ROCK CYCLE - CHEMISTRY (4)**

**PRE LAB**

Students explore the chemical composition of salt.

**OBJECTIVES:**

1. Analyzing the structure of elements.
2. Contrasting atoms, molecules, elements, and compounds.

**VOCABULARY:**

atom
electron
element
molecule
neutron
nucleus
orbital
proton

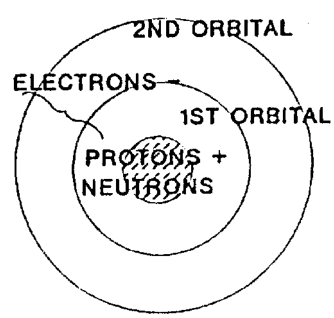
**MATERIALS:**

Periodic Table Placemats
table salt
magnifying glass or hand lens

**BACKGROUND:**

The study of minerals requires a knowledge of atoms, molecules, elements, and compounds. Rocks are made of minerals. Minerals are made of elements. Elements are made of molecules, and molecules are made of atoms.

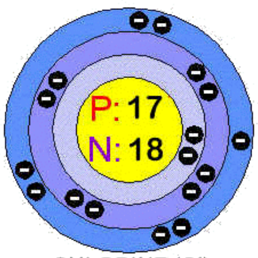
Elements are composed of extremely small particles called atoms. An atom is the smallest part of an element that retains all the characteristics of the element. Atoms are composed of protons, neutrons, and electrons, which are in turn composed of leptons and quarks. These subatomic particles lack the distinct characteristics of elements. Protons and neutrons are made of different types of quarks. Electrons are composed mainly of leptons. Electrons are negatively charged, protons are positively charged, and neutrons are electrically neutral. Neutrons and protons are found within the nucleus of an atom. Electrons orbit the nucleus at distinct distances called orbitals. Each of the orbitals can contain a set number of electrons. For instance, the first orbit from the



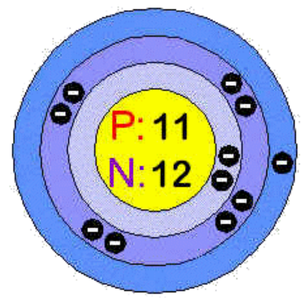
nucleus has 2 electrons, the second has 8, the third has 8, the 4th has 16 and the fifth has 32, and so on. Each shell may not be full, depending on the number of electrons in the element, and the inner shells fill before the outer shells fill. The orbitals are within a plane confined to about 20 degrees of each other.

Most substances found on the Earth usually consist of more than one atom. When two or more atoms form a chemical bond, they create a molecule. A molecule can consist of two or more atoms of the same element ($O_2$) or of atoms of two or more different elements ($H_2O$). When two or more elements combine, they form what is called a compound. A molecule is the smallest distinct part of an element or compound.

In this lab, students will consider halite (table salt) which has the chemical formula NaCl. Sodium (Na) and chlorine (Cl) are very different elements.

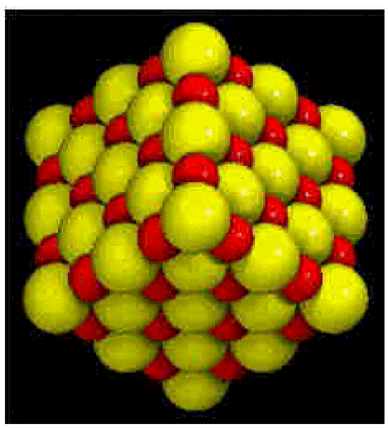


CHLORINE (Cl)



SODIUM (Na)

In its elemental state, chlorine is a greenish-yellow gas that has a melting point of -101 degrees centigrade and a boiling point of -34.1 degrees centigrade. It has 17 electrons in three orbitals. It also has an atomic diameter of 3.62 units (don't worry about the type of units). Sodium melts at 98 degrees centigrade and boils at 889 degrees centigrade. Elemental sodium is a silvery-white metal that can be cut by a knife. It reacts very violently with air or water. It is an excellent conductor of heat and electricity. It has 11 electrons, also in three orbitals. The atomic diameter of sodium is 1.81 units (½ the size of a chlorine atom).

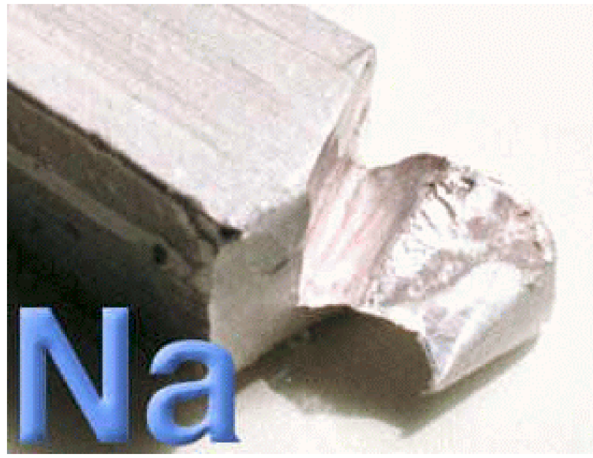


Although sodium and chlorine are very different, they combine to form the compound called halite (NaCl), commonly known as table salt. Halite crystals grow in a cubic form, which reflects how chlorine and sodium combine. Since a sodium atom is half the size of an atom of chlorine, the two elements combine perfectly in a cubic pattern, as shown to the left.

**PROCEDURE:**

1. Review the structure of atoms with your students. Hand out the periodic table placemats. Review the common elements and their symbols. Call out the name of an element, and ask the students give you the symbol. You may want to ask other questions, such as the atomic weight or whether the element is normally a solid, liquid, or gas.

2. Ask the students to locate sodium (Na) and chlorine (Cl) on the placemats. Discuss them in detail as outlined above. Have the students fill in the worksheet, using the information from the periodic chart. Review electrons, protons, and neutrons.



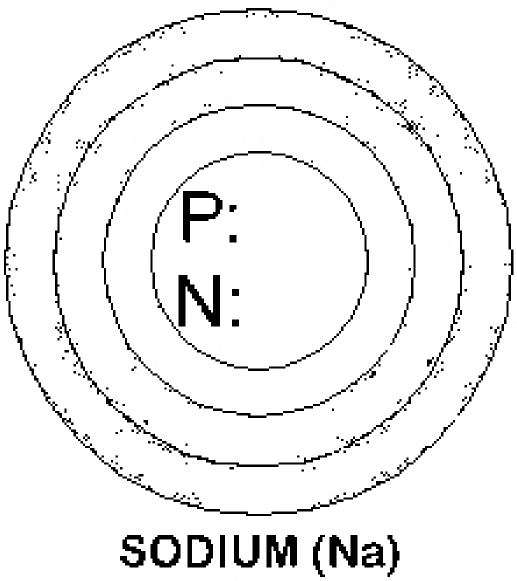

3. Give students a small amount of salt to examine. Ask them if the salt is cubic. (the answer is yes). Challenge the students to find a crystal that is not cubic. (There may be clumps of cubes, but these are still cubic.) Ask them if these are crystals, or crystals that have been broken into little cubes. (The answer may vary, but when broken or "cleaved," salt will still form cubes.)

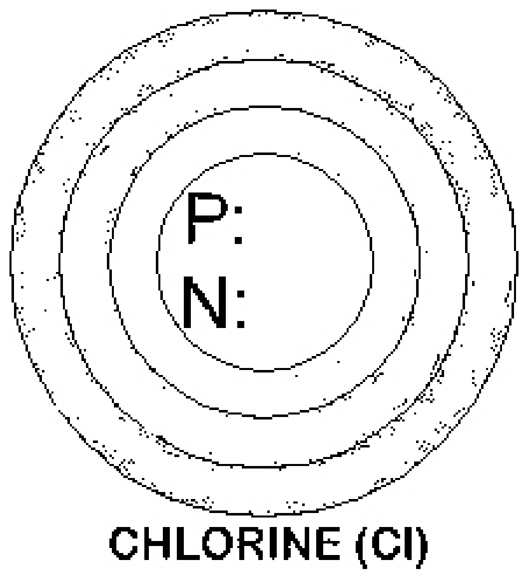
**ROCK CYCLE - CHEMISTRY (4) PRE**

Draw the number of electrons in the 1st, 2nd, and 3rd orbitals around the nucleus of sodium and chlorine.

Protons equal the Atomic Number. Neutrons are the Atomic Mass - Atomic Number. Remember the first orbital has 2 electrons maximum, the 2nd has 8 electrons, and the 3rd has 8 maximum.

How can the sodium and the chlorine "bond" to create a stable molecule of sodium chloride (halite)?




Name: Sodium
Symbol: Na
Atomic Number: 11
Atomic Mass: 23

Name: Chlorine
Symbol: Cl
Atomic Number: 17
Atomic Mass: 35

**ROCK CYCLE - CHEMISTRY (4)**

**LAB**

Students explore the cubic nature of salt.

**OBJECTIVE:**

1. Exploring two elements that form a compound.
2. Investigating the cubic shape of halite.

**VOCABULARY:**

atom
compound
element
halite
molecule

**MATERIALS:**

Rock Cycle - Chemistry (4) or
(salt samples)
Swift-GH microscope

**BACKGROUND:**

A compound consists of two or more different types of atoms that are chemically bonded. Halite, composed of sodium and chlorine, is an example.

Electrons move around the nucleus of an element in specific and set orbitals. There are a finite number of electrons in each of these orbitals. For example, any element can only have 2 electrons in the first orbital, 8 electrons in the second and third orbitals, and 16 in the fourth orbital, and so on.

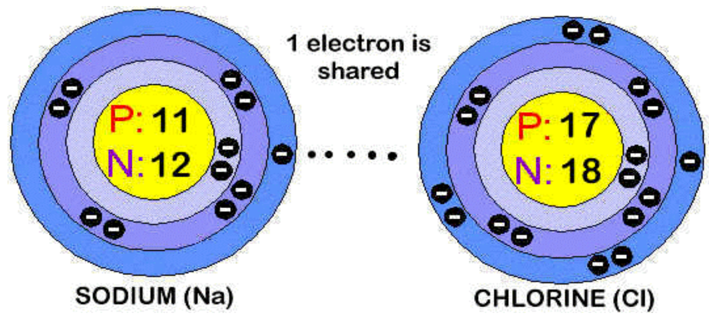
If an atom does not have the full number of electrons in each orbital, it seeks a partner that can "loan" one or more electrons to "fill" its orbital. This is the essential cause of chemical bonding. For example, a sodium ion, which has a positive charge wants to give up an electron whereas a chlorine ion, which has a negative charge wants to accept an electron. The two elements combine to form an ionic bond (bond formed by the attraction of unlike charges) and thus form the compound, halite. There are several additional types of bonding, which students will learn in future years.

The type of bonding between atoms and the characteristics of those atoms determines to a large degree how a compound will "appear" when the atoms combine. In halite, the chlorine atom is twice the size of the sodium atom. When the chlorine atoms "nestle" into a "packed" position, the sodium atoms fill in the gaps. This packed position has a cubic structure, which is reflected in the cubic nature of halite. You can demonstrate this by placing small and large plastic beads in a small, cubic, clear, plastic box. Shake the box. If one bead is twice the size of the other, they will pack in a cubic pattern. The large beads represent chlorine (Cl) atoms and the smaller beads represent sodium (Na) atoms.

**PROCEDURE:**

1. In this lab, the students will look at different specimens of commercial salt from Cargill Salt Company in Newark, California. These include: mill feed - kiln dried, used for animal feed; blending - vacuum dried, used in food processing; granulated - vacuum dried, used in food processing and table salt; pellets - kiln dried, used as water conditioner; medium - kiln dried, used as water conditioner; bakers - vacuum dried, used in making butter. Kiln and vacuum dried refer to the type of process used to make the salt.

2. Summarize the composition and bonding behavior of halite. You might tell your students that the atoms are "holding hands" and are brought together by an "attractive" force. Draw the following diagram on the board for the students to see this "bonding" , or use the electronic presentation. Explain that since chlorine is twice the size of sodium, when they combine sodium fills in the spaces between the chlorine, forming cubes.




3. The students will try to determine if all types of salt are "cubic." They should use a magnifying glass or a microscope to see the specimens in detail. Have them examine the specimens without taking them out of the plastic bags.

4. Ask students to think about why each type is different. Do not give them too many hints, but have them "guess" the use of each specimen. Have them record their guesses on the lab sheet.

5. As they look at the samples, ask the students to draw the salt crystals. Monitor their progress as they work their way through the samples. Remind them to draw accurate pictures (pencils work best for this exercise).

6. Review their answers, then answer the conclusion together. While all of these samples are composed of halite, only the blending, granulated, and baking (all vacuum dried) specimens are cubic. The mill feed and pellets are not cubic, and the medium is only roughly cubic. This is because the cubic structure can be broken if the process of making the salt crushes the crystals (mill feed) or combines the crystals (pellets).

**ROCK CYCLE - CHEMISTRY (4) LAB**

**PROBLEM:** Are all types of commercially used salt (halite), cubic?
**PREDICTION:**_______________________________________________________
**PROCEDURE:** You have 6 samples of salt from the Cargill Salt Company in Newark, California. They commercially produce salt for food, animals, and water conditioning.

Look at the following examples of salt under a microscope. Draw the shapes you see. State what commercial purpose you think each type may have.

| | |
|---|---|
| **MILL FEED** | **BLENDING** |
| **GRANULATED** | **PELLETS** |
| **MEDIUM** | **BAKERS** |

**CONCLUSION:** Which samples maintain the cubic shape? Why might some samples not have a cubic shape?
_______________________________________________________________
_______________________________________________________________

ROCK CYCLE - CHEMISTRY (4)

POST LAB

Students learn about the historical significance of salt.

OBJECTIVE:

1. Exploring the historical significance of salt.
2. Searching for information on salt.

VOCABULARY:

compound
element
halite
mineral
salt

MATERIALS:

The Salt Institute Video
Internet

Solar salt and its red color caused by salt loving bacteria.

BACKGROUND:

Salt is an important resource in the United States and other nations. It is used every day in many aspects of our lives, from manufacturing to water purification. It is also an essential ingredient for maintaining a fluid balance in our bodies.

Salt crystallizes in a cubic pattern, and usually has a cubic appearance in hand specimens. The melting point of salt is 800° C. It dissolves easily in cold water and a little more readily in hot water. Common salt, when mixed with ice, lowers the melting point of the ice, making it melt. Salt is thus used on ice covered streets, so people or cars will not slip.

Common salt is also used in many manufacturing processes. It is employed as a preservative or seasoning in food processing, for curing hides, and as a brine for refrigeration. It is used to make sodium carbonate (washing soda), sodium bicarbonate (baking soda), sodium hydroxide (caustic soda), hydrochloric acid, bleaching powder, and many other chemicals. It is also used as a flux in metallurgical processes. It is also an important ingredient in the manufacture of cement.

Salt, often said to be worth its weight in gold, has played a vital role in nearly every civilization since the beginning of time. It has served to preserve and improve the taste of food, as money, and as a spiritual icon. Some examples are listed below:

- Ancient Greeks exchanged their slaves for salt
- Romans paid their soldiers partly in salt

- Chinese, in 2700 BC, wrote of 40 different kinds of salt
- The French Revolution was sparked, in part, by a salt tax
- Ancient Ethiopians used salt disks as a form of currency
- In the United States, the Erie Canal was built largely to transport salt
- In Slavic countries, salt is given to a bride and groom to symbolize health and happiness
- Many of Napoleon's troops died during retreat from Moscow due to a lack of salt
- The English increased their use of salt during Queen Elizabeth's reign when she required her subjects to eat fish on Wednesday and Friday

**PROCEDURE:**

1. Show the Salt Institute video (can be purchased from The Salt Institute website listed below). This presentation shows that salt is essential for life. It will take students to far away places and trace the historical importance of salt. It explores the collection and packaging of salt, as well as its various forms and uses throughout the United States, (including the "mining" and harvesting technology used in the San Francisco Bay area.)

2. Have the students write a paragraph on the importance of salt. They can find information in the library or search the internet. You may want to start with The Salt Institute web site which is full of historical information (http://www.saltinstitute.org.)