

1.

Name: Copper

**Chemical Symbol or
Formula**

Cu

Card #1

Copper is a good conductor of electricity and a ductile metal (easily drawn into wire).

Copper wire is widely used for electrical wiring.

Copper is also a constituent of many alloys:

Bronze is an alloy of copper and tin.

Brass is an alloy of copper and zinc.

In air copper slowly oxidizes to copper oxide (**black** color). $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$

then eventually to a **green** color which is the result of formation of **copper carbonate**.

The Statue of Liberty is green colored because of the reaction of copper to the air.

$2\text{Cu} + \text{H}_2\text{O} + \text{O}_2 + \text{CO}_2 \rightarrow \text{Cu}_2(\text{OH})_2\text{CO}_3$ The green material is actually a 1:1 mixture of

[\$\text{Cu}\(\text{OH}\)_2\$](#) and CuCO_3 :

Some architects use copper on rooftops for this interesting color.

2.

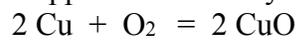
Name: Copper Oxide

**Chemical Symbol or
Formula**

CuO

Card #2

Copper reacts slowly with oxygen to produce copper oxide.



This is the compound seen as a coating on an old penny.

Copper oxide is used as a pigment in ceramics to produce blue, red, and green glazes.

3.

Name: Copper Sulfate

**Chemical Symbol or
Formula**

CuSO₄

Card #3

Copper sulfate is used as a fungicide, herbicide, and pesticide and is put into drains to kill invading roots from trees.

A dilute solution of copper sulfate is used to treat aquarium fish for parasitic infections, and is also used to remove snails from aquariums. Copper ions are highly toxic to fish, so care must be taken with the dosage.

Most species of algae can be controlled with very low concentrations of copper sulfate.

4.

Name: Sodium Bicarbonate
(Baking Soda)

**Chemical Symbol or
Formula**
NaHCO₃

Card #4

Sodium bicarbonate, NaHCO₃, is commonly referred to as baking soda because it releases CO₂ on

contact with acids and causes dough to expand during baking.

Baking soda can react as both an acid and a base in water. For example, it can be used as an antacid

and is one of the components of Alka-Seltzer. (A recipe for homemade antacid is to mix a teaspoonful

of baking soda in a glass of orange juice.)

Baking soda is also in some toothpastes because of its abrasive properties.

5.

Name: Tin

**Chemical Symbol or
Formula**

Sn

Card #5

Tin is not easily oxidized in air and so is used to coat other metals to prevent corrosion.
Tin cans that are used for food packaging are tin-plated steel.
Bronze is an alloy of tin and copper.

6.

Name: Sodium chloride
(Salt)

**Chemical Symbol or
Formula**
NaCl

Card #6

Sodium chloride is obtained from seawater and other natural brines found in wells and lakes, such as the Great Salt Lake in Utah. After evaporation from water, the salt is purified.

A major use is for the production of chlorine and sodium hydroxide.

[Chloride](#) and [sodium](#) ions, the two major components of salt, are needed by all known living creatures in small quantities.

Salt is involved in regulating the [water](#) content ([fluid balance](#)) of the body. The sodium ion itself is needed for electrical signaling in the nervous system.

7.

Name: Iodized Salt
99.097% NaCl, 0.003% KI

**Chemical Symbol or
Formula
NaCl with KI**

card # 7

Salt for human consumption is produced in different forms: unrefined salt (such as [sea salt](#)), refined salt (table salt), and [iodized salt](#).

Iodized salt is 99.097% NaCl (sodium chloride) with 0.003% KI (potassium iodide) added to provide the essential trace mineral **iodine**.

Iodine is necessary for a healthy thyroid gland. An unhealthy thyroid can lead to a number of conditions, including goiter, a swelling of the thyroid gland.

A package of iodized salt will always be clearly marked, indicating that it contains dietary iodine.

8.

Name: Soil

**Chemical Symbol or
Formula**

?

Card #8

Soil is a mixture of four components – mineral particles, organic matter, water, and air. Weathering processes in nature over thousands of years break down rock into small mineral particles found in soil. Organic matter in soil is a mixture that includes leaves, twigs, plant and animal parts in various states of decomposition, and microorganisms. Humus, the dark-colored decomposed organic material, is important to a good soil structure.

9.

Name: Aluminum

**Chemical Symbol or
Formula
Al**

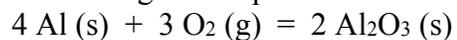
Card #9

You probably know aluminum best as a container for beverages or as a food wrap. Aluminum is the third most abundant **element** and the most abundant **metal** in the earth's surface.

Aluminum is a light (about one third as dense as iron) but strong metal with many uses. Because of its lightness and strength, aluminum is used widely in aircraft construction. It is a good electrical conductor.

Aluminum is very resistant to corrosion because it reacts readily with oxygen and forms an inert coating of aluminum oxide (Al_2O_3) that protects the surface of the aluminum.

This oxide coating is transparent.



10.

Name: Magnesium

**Chemical Symbol or
Formula**

Mg

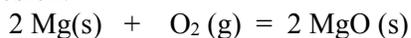
Card #10

Magnesium is the lightest structural metal and is similar to aluminum in its uses. Many alloys designed for light weight and great strength contain magnesium.

Because it is light, strong and a good electrical conductor, it is widely used in the manufacture of mobile phones, laptop and tablet computers, cameras, and other electronic components.

Magnesium is used in engine components by many car manufactures. High-grade car wheels of magnesium alloy are called "mag wheels".

Like aluminum, magnesium reacts readily with oxygen producing a transparent, chemically inert coating of magnesium oxide (MgO) that protects the surface of magnesium, making it highly resistant to corrosion.



It burns with a bright white light and can be used in fireworks. It was used in the firebombing of cities in WWII.

11.

Name: Magnesium Sulfate
(Epsom Salts)

**Chemical Symbol or
Formula**
MgSO₄

Card #11

Epsom Salts occur naturally as a mineral called epsomite.

Magnesium sulfate can be found in the grocery store and is used as bath salts. The soothing soak can relax the body and relieve tension. Epsom salt soaks are also used to reduce swelling and to treat bruises or sprains.

In gardening and other agriculture, magnesium sulfate is used to correct a magnesium or sulfur deficiency in soil.

12.

Name: Iron

**Chemical Symbol or
Formula
Fe**

Card #12

Iron is the most common element on earth, but only the fourth most abundant element in the **Earth's crust**.

Pure iron reacts easily with oxygen and water and so most of the world's iron exists as an iron oxide such as hematite and magnetite. These iron ores are reduced in a blast furnace to give pig iron, which contains many impurities.

When **molten pig iron** is poured into molds of a desired shape (engine blocks, brake drums, transmission housings), it is called **cast** iron. However, pig iron and cast iron contain too much carbon and other impurities for most uses.

Pure iron is soft so is converted to **steels** (see card # 15).

Iron is important in biology – it is a necessary trace element in most living organisms. The color of blood is due to the iron-containing protein hemoglobin.

13.

Name: Iron Oxide
(Ferric oxide, rust, hematite)

**Chemical Symbol or
Formula**
Fe₂O₃

Card #13.

This iron oxide occurs naturally as the mineral hematite. It is commonly known as **rust**. It is the main source of iron for the production of iron, steel and alloys. It can be used as a pigment.

14.

Name: Iron Oxide
(Magnetite)

**Chemical Symbol or
Formula**

Fe₃O₄

Card #14

There are 16 different iron oxides.

Fe₃O₄ is found in nature as the **magnetite**, the most magnetic mineral found on Earth.

The compound contains both +2 and +3 iron ions and its formula can be written as FeOFe₂O₃ to emphasize the different oxidation states of iron that are present.

It is used as a black pigment. Nano particles are used in ferrofluid.

15.

Name: Steel

**Chemical Symbol or
Formula**

**Fe alloyed with C, and
small amounts of other
metals**

Card #15

There are two types of steels: carbon steels and alloy steels.

1. Alloy steels contain iron, carbon and **other metals** in small amounts. The other metals determine the properties of the alloy steel. For example, a common stainless steel contains 18% chromium and 8% nickel alloyed with a low-carbon steel.

2. Carbon steels are mainly iron mixed with **small amounts of carbon**.

Mild carbon steels contain less than 0.2 % carbon and are malleable and ductile.

Medium carbon steels with 0.2 % to 0.6 % carbon are used for structural steel, such as steel beams and steel girders.

Hard carbon steels contain 0.8% to 1.5% carbon and are used to make drill bits, knives, and other tools.

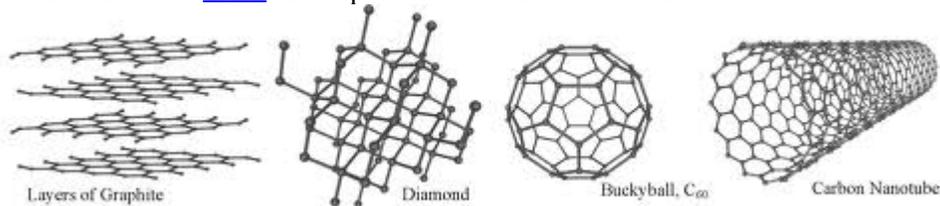
16.

Name: Carbon

**Chemical Symbol or
Formula**
C

Card #16

Carbon forms more [compounds](#) than any other element. The different forms (*allotropes*) of carbon include the hardest naturally occurring substance, [diamond](#), and also one of the softest known substances, [graphite, as well as Bucky balls and nanotubes](#). Carbon compounds form the basis of all known life on [Earth](#) and is present in all known life forms.



http://www.teachers.yale.edu/curriculum/viewer/initiative_10.05.07_u

17.

Name: Calcium Carbonate

**Chemical Symbol or
Formula
CaCO₃**

Card #17

Calcium carbonate is a common substance found in [rocks](#) in all parts of the world – examples are limestone, marble and chalk. It is the main component of sea shells, snail shells, pearls, and eggshells.

Calcium carbonate reacts with water that is saturated with carbon dioxide (in nature this would be rain water or water that has percolated through humus) to form the soluble [calcium bicarbonate](#):

$\text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{HCO}_3)_2$ This reaction is important in the [erosion](#) of [carbonate rocks](#), forming [caverns](#), and leads to hard water in many regions.

18.

Name: Marble

**Chemical Symbol or
Formula**

**CaCO₃ plus other minerals
such as dolomite**

CaMg(CO₃)₂

Card #18

Marble is a metamorphic rock composed of carbonate minerals, most commonly calcite (CaCO₃) or dolomite (calcium magnesium carbonate CaMg(CO₃)₂). Marble is formed in nature from layers of limestone that are subjected to pressure.

Pure marble is white and the many colored marbles are a result of the presence of different mineral impurities such as clay, silt, sand, iron oxides or chert.

Marble is commonly used for sculpture and as a building material.

19.

Name: Household Ammonia
(5% ammonia in water)

**Chemical Symbol or
Formula**

NH₃ dissolved in H₂O

Card #19

Ammonia gas is a colorless **compound** and has a [pungent smell](#). It is called anhydrous ammonia and is toxic, flammable and can form explosive mixtures with air. It has many uses, including making fertilizers.

Household ammonia is a 5% solution of ammonia in water and is a weak base. Household ammonia is used as a general purpose cleaner for many surfaces.

20.

Name: Vinegar
(5% Acetic Acid in water)

**Chemical Symbol or
Formula**
**CH₃COOH dissolved in
H₂O**

Card #20

Undiluted (anhydrous) acetic acid is called glacial acetic acid and is a compound used in industry.

Vinegar is a 5% solution of acetic acid in water and is commonly used in food preparation – in pickling, salad dressings, and as an ingredient in mustard, ketchup, and mayonnaise.

Vinegar is often used as a household cleaning agent. Because it is acidic, it can dissolve mineral deposits from glass, coffee makers, and other smooth surfaces.

21.

Name: Sand

**Chemical Symbol or
Formula**

**SiO₂ or CaCO₃ with
various mineral impurities**

Card #21

Sand is any loose granular material that results from the disintegration of rocks and consists of particles smaller than gravel but coarser than silt.

There are many sands, depending on the local rock sources. Sands found in inland areas are usually from weathered quartz mineral and contain a lot of silicon dioxide, SiO₂.

Sand found in the Caribbean comes from weathered sea shells and corals and contains mostly calcium carbonate, CaCO₃. Sands found in volcanic areas can be dark from the volcanic basalt, or green from the mineral olivine.

22.

Name: Zinc

**Chemical Symbol or
Formula
Zn**

Card #22

Major uses in the United States include galvanization (55%), in alloys (37%), and other miscellaneous uses (8%).

Zinc is widely used as an anti-corrosive agent. Zinc coatings prevent corrosion of iron or steel by reacting with oxygen to form a thin coating of zinc oxide that protects the surface from corroding.

Galvanization is the process of applying a protective zinc coating to steel or iron to prevent rusting.

Brass is an alloy of copper and zinc and has been used since the 10th century BC.

Zinc plays an important role in keeping humans healthy and is often found in vitamin supplements.

23.

Name: Penny

**Chemical Symbol or
Formula**

Zn (97.5%) and Cu (2.5%)

card # 23

Until 1982, the composition of U.S. pennies was 95% copper and 5% zinc. By that time the value of copper had increased to the point where the penny was worth more than one cent. Since zinc is less expensive than copper, the composition of the penny was changed in 1982 to 97.5% zinc with a 2.5% coating of copper. However, a penny now costs 2 cents to produce so attention is again focused on how to produce pennies cheaper, or even the possibility of eliminating the use of pennies. Canada has withdrawn the Canadian penny from circulation, effective February 4, 2013.

Since 1982, Jarden Zinc Products, located in Greenville, Tennessee, has supplied the penny blanks – the zinc metal discs that become pennies after being coated with copper. Since the outside coating of the penny is copper, the penny looks like copper metal and has the properties of copper metal.

24.

Name: Sucrose (sugar)

**Chemical Formula or
Symbol**

$C_{12}H_{22}O_{11}$

Card #24

The sugar in the vial is table sugar, and its chemical name is sucrose. There are several other sweet-flavored substances also known as sugars, such as fructose, glucose, lactose etc. All sugars are carbohydrates, composed of carbon, hydrogen and oxygen. Sucrose is a disaccharide, composed of 1 molecule of fructose and 1 glucose. It is extracted from sugar cane or sugar beet plants.

25.

Name: Cobalt

**Chemical Symbol or
Formula
Co**

Card #25

Pure cobalt is a metal that is not found in nature but is manufactured from cobalt compounds.

It has been used for centuries to add a blue color (cobalt blue) to glass and ceramics.

Cobalt is primarily used in making alloys. Some uses of these alloys include turbine blades for jet aircraft engines and orthopedic implants.

Cobalt is ferromagnetic. Alloys of aluminum, nickel, cobalt and iron, known as Alnico, and of samarium and cobalt (samarium-cobalt magnet) are used in permanent magnets.

26.

Name: Cobalt chloride

**Chemical Symbol or
Formula**

CoCl₂

Card #26

The most common form of CoCl₂ is the hexahydrate, i.e. it has 6 water molecules attached to it. Its chemical formula is CoCl₂.6H₂O and is a deep purple color. When there is no water attached (called the anhydrous form with formula CoCl₂,) it is a sky-blue color. Mixtures of the 2 would be mauve. What form is in the vial?

27.

Name: Nickel

**Chemical Symbol or
Formula
Ni**

Card #27

Nickel is used in many industrial and consumer products, including stainless steel (card 15), alnico magnets (card #25), coinage, rechargeable batteries, electric guitar strings, microphone capsules, and special alloys.

The U. S. nickel is a five-cent coin is an alloy composed of 75% copper and 25% nickel.

28.

Name: Nickel chloride

**Chemical Symbol or
Formula**

NiCl₂

Card #28

Nickel chloride is primarily used to synthesize other compounds and as a reagent in organic synthesis.

Many nickel(II) compounds are [paramagnetic](#).

29.

Name: Cream of Tartar

**Chemical Symbol or
Formula**

$\text{KHC}_4\text{H}_4\text{O}_6$

Card #29

Cream of Tartar is a weak acid and is also known as potassium bitartrate.

Potassium bitartrate forms crystals in wine casks during the [fermentation](#) of [grape juice](#), and can precipitate out of wine in bottles. These crystals also precipitate out of fresh grape juice that has been chilled or allowed to stand for some time.

It is used in several cooking applications, including stabilizing whipped cream or eggs and is a major component of baking powder.

You can make your own baking powder by mixing 2 parts Cream of Tartar with one part baking soda and 1 part cornstarch.

30.

Name: Sulfur

**Chemical Symbol or
Formula
S**

Card #30

Sulfur is referred to in English translations of the [Bible](#) as *brimstone* (burn stone) in [English](#). It was needed to make the best quality of [black gunpowder](#). Being abundant in native form, Sulfur occurs naturally and was known in ancient times. Fumes from burning sulfur were used as fumigants, and sulfur-containing medicinal mixtures were used as balms and antiparasitics. Many sulfur compounds have strange smells (as in rotten egg/skunk/garlic odors).

The largest use of sulfur is in the production of sulfuric acid, the number one chemical in the United States.

More than 70% of sulfuric acid is used in the manufacture of fertilizers with the rest being used in the petroleum industry, in car batteries, in the production of steel and the manufacture of organic dyes, plastics, drugs, and many other products.

31.

Name: Water

**Chemical Symbol or
Formula
H₂O**

Card #31

Water would be a gas at room temperature if it weren't for **hydrogen bonding**. Hydrogen bonds are weak bonds between the hydrogen of one water molecule and the oxygen of another water molecule. Each water molecule in liquid water is hydrogen bonded to four other water molecules. This causes water to be a liquid at room temperature and also to have a wide liquid range from 0 to 100 degrees Celsius.

The hydrogen bonding in water also gives water several other unique properties that are important to life. For example, the density of ice is less than water. If ice were a normal solid, it would be denser than liquid water, and lakes would freeze from the bottom up. This would have disastrous consequences for marine life, which could not survive in areas with winter seasons.

Other properties of water that are unique because of hydrogen bonding include: a high heat capacity, a high heat of vaporization, and a high surface tension.

32.

Name: Air

**Chemical Symbol or
Formula**

**Contains N₂, O₂, CO₂, Ar, &
other gases**

Card #32

Dry air contains (by volume) 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.039% carbon dioxide, and small amounts of other gases. Atmospheric air also contains a variable amount of water vapor, on average around 1%.