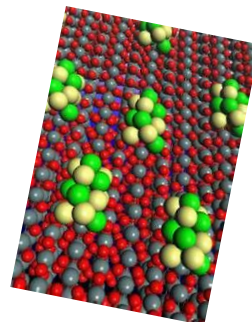


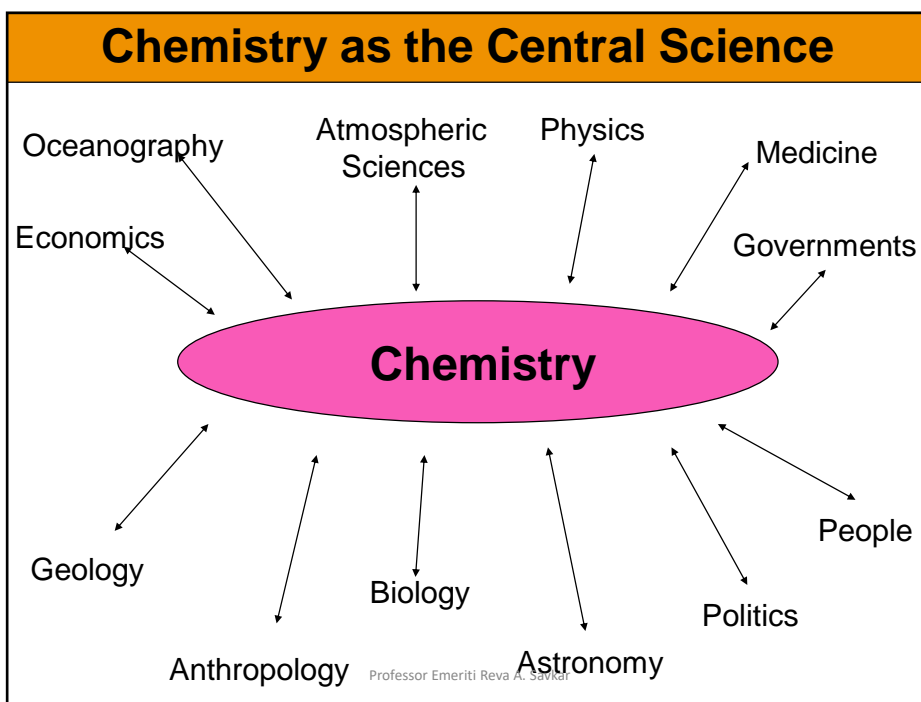
# Molecules of Life & Elemental Tales



**NOVA** | Northern Virginia  
Community College

Professor Emeriti Reva A. Savkar

Chemistry deals with matter at the sub-atomic level, the nano level, the conceptual level and on the macro level. Each of these challenge the ability of humans to truly visualize and comprehend, and art which includes models, designs, figures and animations, is the best medium to truly make the Invisible Visible! For centuries Chemistry was the art of making substances, today it the science of molecules and their transformations. Must be predictable and reproducible, so the process for synthesizing aspirin works in Mumbai, Beijing and Nairobi.



Chemistry is a science, a way of asking and answering questions about our physical surroundings. Chemistry is the study of matter, properties and changes of matter and accompanying energy changes., which make up the Universe- so chemistry is the study of everything! Chemistry is the “central science” because it is the foundation for and there are direct links between chemistry and the life sciences, the earth sciences and the physical sciences. The Life Sciences- zoology, botany, anatomy, genetics, medical sciences- all study the living organism, which is a chemical entity, and chemicals flow continuously between the living organism and its environment. In fact a living cell is a perfect example of a highly efficient chemical factory. In the Earth Sciences, including geology and oceanography, chemistry forms the foundation for the study of the Earth, its crust, inner layers, the ocean, sea and river beds, all the fresh and saline waters and the atmosphere, which are all based on matter and energy,, and the Physical Sciences including astronomy. All matter on earth, including recently synthesized elements, is space debris, so we are truly star dust, formed as a result of intergalactic events, billions and billions of years ago made up of elements- the building blocks of Nature!.

# Taco Salad-Molecules of Life

Proteins, Carbohydrates, Lipids, DNA & RNA, Vitamins and Minerals



Professor Emeriti Reva A. Savkar

All matter is made up atoms of elements which are the building blocks of everything, from simple molecules like methane that contains only 5 atoms, to highly complex molecules made up of thousands of atoms of different elements. Atoms combine chemically to form molecules and one group of molecules are of great interest and importance “The Molecules of Life”. Most molecules in living systems are based on the chemistry of carbon, and just four elements out of the hundreds of elements, that is hydrogen, oxygen, carbon and nitrogen, comprise 99.4% by mass of the atoms in our bodies. Let’s use one of our favorite foods, the ubiquitous Taco Salad, to relate to and understand “The Molecules of Life”: the Proteins – meat and beans, the Carbohydrates -tortilla shell, taco chips, the Lipids– oil, cheese, sour cream, avocado, the Vitamins and Minerals - lettuce, tomatoes, lime, and the DNA and RNA that make it all possible

# Proteins - Work Horses of Life

primarily made up of C, H, O, N

Meat, nuts, eggs, legumes are good sources



Professor Emeriti Reva A. Savkar

Building blocks of proteins are 20 amino acids that are common to all living cells. All 20 amino acids are needed but humans can synthesize 11 of them, but 9 must be part of diet, so they are called essential amino acids. Eggs, milk, meat, fish, poultry and some plant based proteins such as soya, buckwheat, quinoa are called complete proteins because they contain all 9 essential amino acids. Beans, nuts, rice and other grains that are deficient in one or more essential amino acids can be combined to provide complete proteins. 1 gram of protein can provide 4 food Calories of energy (1 Calorie is the nutritional unit = 1000 calories). Proteins play key roles in living systems, they form building materials from which large structures are formed such hair, nails, tendons,, connective tissues, cells. They regulate movement across cell walls, serve as enzymes, control rates of chemical reactions- two or more small molecules bond to form complex molecule, or a large molecule breaks down to form simpler molecules. Aspirin helps to relieve pain and inflammation by blocking the action of an enzyme (a protein) that facilitates the production of prostaglandins, which affect the transmission of nerve signals. Designer drugs are molecules with the right shape and structure to block or alter traffic in and out of cell; Captopril used for hypertension, works by blocking the action of an enzyme (protein). Drugs for psoriasis, glaucoma, AIDs, arthritis, cancers

# Carbohydrates: made up of C, H, O

Play a central role in energy acquisition & use in all living cells- include sugars, starches and fibers.

Grains, vegetables & nuts are good sources



Professor Emeriti Reva A. Savkar

Sugars such as sucrose, glucose are involved in energy metabolism of all living things, supply each cell with energy. Fructose, similar to glucose but has a different arrangement, can only be in the liver, muscles, stored as glycogen, then converted to glucose as needed. Molecules of sucrose, glucose, fructose can be linked together to form complex carbohydrates,, must be broken down by enzymes in the body. Long chains of glucose- starch in grains, potatoes, corn are broken down by enzymes releasing glucose; humans lack the enzymes needed to breakdown cellulose in plants, so cannot digest cellulose, but the fiber is necessary for the smooth working of the intestinal tract, they may limit cholesterol absorption, and help passage and excretion through the system. 1 gram of carbohydrates can provide 4 food Calories of energy (1 Calorie is the nutritional unit = 1000 calories)

# Lipids: made up of C, H, O & some with P

Oils, olives, nuts & dairy are good sources

Present in cells and tissues of all living things, feature in cell membranes, fat-soluble vitamins and steroid hormones.



Professor Emeriti Reva A. Savkar

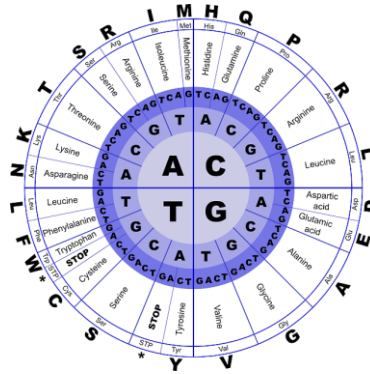
Lipids are C, H, O containing molecules, a few with P called phospholipids. Oils, olive oil, canola oil to name a few, avocado, dairy are good sources. Lipids are insoluble in water, are present in cells & tissues of all living things. They feature in cell membranes, fat-soluble vitamins and steroid hormones. As a class Lipids include Fats & Oils in Food, and Waxes, Grease and Lubricants.

Saturated Fats - all the carbon atoms are bonded to four other atoms. Dietary saturated fats provide raw materials for the body to synthesize cholesterol, which is an essential component of all cell membranes. High levels of blood cholesterol can lead to clogged arteries, heart disease. Unsaturated Fats— some carbon atoms are bonded to three or two other atoms. The monounsaturated and polyunsaturated fats are less likely to cause clogged arteries & heart disease. The process of hydrogenation involves the addition of H to unsaturated fats to change their texture and consistency: for example the partial or complete hydrogenation of liquid oils, to make them solids at room temperature. Thus making them spreadable similar to butter. 1 gram of lipids can provide 9 food Calories of energy (1 Calorie is the nutritional unit = 1000 calories). Excess intake of fat, protein or carbohydrates is converted by the body to adipose fat,, used as a reserve of nutrients, stored energy. Adipose fat is located beneath the skin and around internal organs and cushions and insulates the body.

# Nucleic Acids DNA & RNA

Found in the nucleus -carry and interpret the genetic code,govern and design inheritance of traits and chemical operations of the cell

- DNA of all living cells is made up of the same elements- Carbon, Hydrogen, Oxygen, Nitrogen and Phosphorus.



Professor Emeriti Reva A. Savkar

Nucleic Acids DNA and RNA carry and interpret the genetic code – they govern and design inheritance of traits and chemical operations of the cell. They are found in the nucleus, and the DNA of all living cells is made up of the same four elements- Carbon, Hydrogen, Oxygen, Nitrogen and Phosphorus.

DNA and RNA are made up of nucleotides, which consist of 3 kinds of molecules, which serve as the building blocks.:

the 5 carbon atom sugars, Deoxyribose sugar in DNA and Ribose sugar in RNA,

the Phosphate ion “P” – consisting of one phosphorus atom surrounded by 4 atoms of oxygen, with an overall charge of -3

and the bases - in DNA the bases are Adenine, Thymine, Guanine, Cytosine, and in RNA the base Thymine is replaced by the base Uracil.

The sugars and the phosphate ion form a chain, and the bases are attached to (hang from) the sugars. In DNA two chains bond, with bases from one chain linking to complementary bases from the other chain, forming a twisted ladder like a spiral staircase. This forms a double helix, the structure of which was discovered by scientists Rosalind Franklin, Francis Crick and James Watson. DNA contains the code of life! Chromosomes are primarily made of long strands of the DNA double helix, humans have 23 pairs (46) chromosomes, one from each parent, with each chromosome carrying many genes. A gene is the basic physical & functional unit of heredity. There are more than 25,000 genes in humans, made up of DNA, that act as instructions to make molecules called proteins - one gene carries the information to synthesize one protein. In humans, genes vary in size from a few hundred DNA bases to more than 2 million. RNA is involved in the complex process of converting the information stored in the DNA into protein. DNA is needed to make protein, protein is needed to make DNA!

**Vitamins**-complex molecules that serve a wide variety of functions and play an essential role in good health. Most were discovered through the study of diseases caused by chemical deficiencies – vegetables and fruits including limes, tomatoes, and peppers are good sources



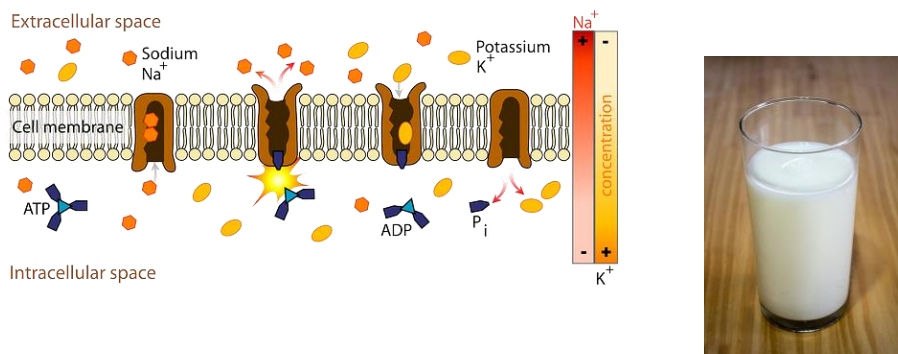
Professor Emeriti Reva A. Savkar

Vitamins are complex molecules that serve a wide variety of functions in the body and play an essential role in good health.

Scurvy is caused by a deficiency of Vitamin C, ascorbic acid. The symptoms include soft gums, teeth and hair falling out, difficulty walking and concentrating. English sailors were given lime juice to combat this deficiency in their diet during long voyages without fruits and vegetable. This led to the slang term “Limeys” for British sailors! Rickets is a disease caused by deficiency of Vitamin D, (also mental health, cancer prevention) and night blindness caused by deficiency of Vitamin A. Vitamin K has a role in essential clotting function. Many vitamins assist enzymes in mediating the body’s chemical reactions, so they are called co-enzymes. With one exception they cannot be made in the body, must be part of dietary intake. Vitamin D can be produced in the body through UVB radiation on the skin using cholesterol as precursor, but in limited quantities in some areas. So limiting sun adversely affects the production Vitamin D. Water soluble vitamins B and C must be replenished daily, while the fat soluble vitamins A, D, E and K can be stored in the body, but overdosage could lead to harmful consequences, toxicity.



**Minerals-** in the nutritional context consist of all elements in food other than C, H, O, N. Sour cream, cheese, tomatoes, avocados (dairy, vegetables, fruits) are good sources



Professor Emeriti Reva A. Savkar

Dairy, vegetables and fruits are good sources. The most abundant in humans is calcium which is 2% of body weight

The gradual loss of calcium is a major cause of bone disease and injury. Potassium K, Chlorine Cl, Sodium Na, Magnesium Mg ions, serve as electrolytes, in cellular fluids, to maintain acidity and control electrical charges in nerve processes. Iodine I, Iron Fe, Zinc Zn, Lithium Li, Selenium Se, Magnesium Mg, and Chromium Cr are trace elements essential for healthy bodies. Deficiencies can cause major health issues such as Li deficiency causes mood disorders, Mn deficiency causes skeletal deformation, I deficiency causes disruption in thyroid hormone production, which keeps the heart, brain, muscles working. Iodine deficiency leads to mental retardation, sluggishness, etc

# Chemistry, Art, Food & Fun

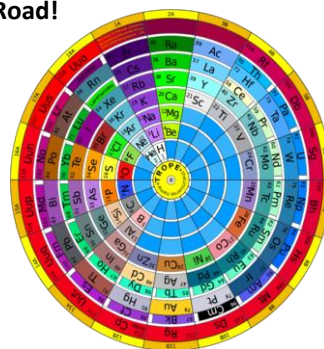


I have fun with my “The Molecules of Life” – cooking, for me, is more than putting food on the table. It is an act of love and nurturing! I rarely follow recipes, I create dishes with what I have in my mind, refrigerator and pantry, and always include texture, color, shape, aroma, taste and nutrition in my art for the dinner table!

# The Table of the Elements

## Building Blocks of the Universe

Follow the **Yellow** Brick Road!



**“Sometimes we see Truth  
through Science, imagine it through  
Art, and discern it through Faith.”**

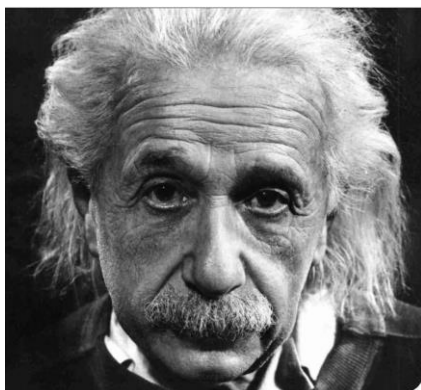
***Liz Lerner***

**“There are in fact two things: to know and  
to believe one knows. To know is Science, to  
believe one knows is Ignorance.”**

***Hippocrates***

Professor Emeriti Reva A. Savkar

The Periodic Table gracefully and powerfully holds information about the elements, their physical, chemical and nuclear properties & their relation to one another. This is a brief journey through the cultural, economic and social facets of some of the elements.



**"There is no true greatness in Art or Science without the sense of Harmony.  
The most beautiful thing we can experience is the mysterious.  
It is the source of all true Art and Science"**

***Albert Einstein***

Professor Emeriti Reva A. Savkar

I always started each semester by telling students that I hope to bring to them the beauty of the Universe, through Chemistry! The harmony in Nature is mirrored in our growing awareness, as we, little by little, uncover the mysteries, and attempt to make sense of that which cannot be seen, appears abstract, but is more real than anything else in our world and must be understood.

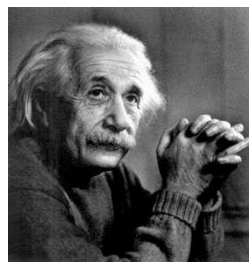
**“Science is essentially international, and it is only through lack of the historical sense that national qualities have been attributed to it.”**

***Marie Curie***



**“One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike—and yet it is the most precious thing we have.”**

***Albert Einstein***



Professor Emeriti Reva A. Savkar

Our elements have been named for countries, people, planets and mythological figures, mainly focused on the Western and Northern Hemispheres, however their cultural mark can be traced through all of mankind, across all man-made boundaries over the past couple of millennia.

# Mysterious Building Blocks of the Universe

## The Elements

“ Each Element embarks upon a Journey into our Culture.

The Elements do not belong in a laboratory:  
they are the property of us all.

They may be visible everywhere, like iron or carbon.

They may loom economically or politically like silicon or plutonium.

Or detach completely from the element itself:  
platinum blondes and platinum credit cards.”

*Hugh Aldersey-Williams*

Professor Emeriti Reva A. Savkar

Very few elements exist in nature in their elemental state and yet their names give us almost an instant picture of important economic, social or political phenomenon. Plutonium: conjures up Atomic bombs, End-of-the-World scenarios, Silicon: the unbelievable electronics and economic revolution driven by the computer, and chlorine: the image of hundreds of children splashing and frolicking in swimming pools filled with “clean and safe” water. The elements can be claimed by all as their own “molecules of every-day life” irrespective of their position in the Periodic Table, their exhibited properties, or chemical or physical form

## Turning STEM into STEAM Art in Nature's Element

“Innovation in the Sciences is always linked in some way, either directly or indirectly, to a human experience. And human experiences happen through engaging with the Arts – listening to music, reading a poem or seeing a piece of art.”

*John Maeda*

*Author, Graphics Designer, Computer Scientist*



Professor Emeriti Reva A. Savkar

Connections between discovery and application depend on understanding human nature, chemical properties and some serendipitous unfolding. The MRI, Magnetic Resonance Imaging, is one of most powerful and commonly used diagnostic tool. Its scientific name is Nuclear Magnetic Resonance (NMR) but the medical application is called MRI which does not sound intimidating, with the word “nuclear” removed because patients were hesitant about being exposed to anything associated with the word “nuclear”.

Creator of the First Version of the Periodic Table of Elements  
Predicted the properties of elements yet to be discovered.

“Art helps you see things in a less constrained space.

Artists and Designers are divergent thinkers:

they expand the horizon of possibilities.

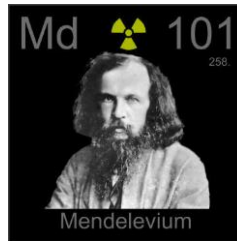
Scientists and Engineers are convergent thinkers:

they focus on the evidence.

Superior Innovation comes from bringing together Divergents and Convergents.”

*John Lehrer*

Professor Emeriti Reva A. Savkar



Dmitri Mendeleev



Mendeleev’s amazing painstaking arrangement of the known elements in a pattern and his imagination, vision and analytical ability to predict the existence and probable properties of as yet unknown elements, is one of the most outstanding examples in one person, of divergent and convergent thinking working in harmony. His picture is one of the best one recognized by scientists, interestingly the element Mendelevium has absolutely zero use in the real world. Two interesting facts about him that are not connected to each other at all -that Mendeleev set the standard for vodka in Russia – 40% alcohol (80 proof), and his nomination for Nobel prize was rejected

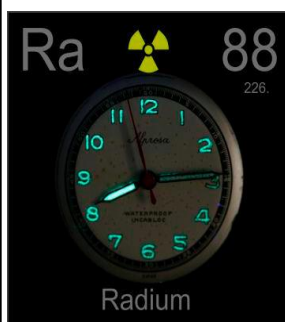


# Marie Sklodowska Curie

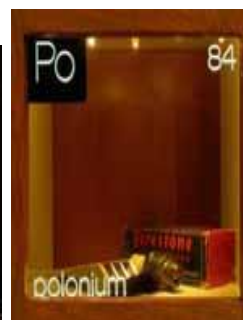
Only Person to receive two Nobel Prizes in Multiple Sciences

Physics 1903 & Chemistry 1911

Discovered two elements and had a third named in her honor



Radium Girls



Professor Emeriti Reva A. Savkar

Marie Sklodowska Curie discovered two elements, Radium and Polonium. The harmful properties of Radium were not known for many years after its discovery by Marie Curie. Radium was used to make self-luminous paints for watches, aircraft instrument dials and other instrumentation from 1917 in the US. Women were the primary factory workers using radium based paint. The women were instructed to point the paint brushes on their lips to shape them and suffered high incidence of serious illnesses from the exposure to radium. The last of the "Radium Girls" Mae Keene, 107 died March 1 2014.

The element Polonium: Poland was under Russian, Prussian, and Austrian partition, and did not exist as an independent country for many decades and Marie Curie hoped that naming the element after her native land would publicize its lack of independence. Polonium is first element named to highlight a political controversy. It played an important role in the first two atom bombs – it was used as the trigger center. In 1996 Polonium was used in the killing of a former high KGB member in the UK



## Aluminum

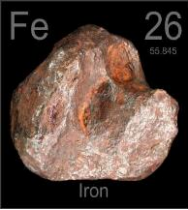


- Hydrangeas
  - Blue, Pink & Purple
- Level of acidity in the soil
  - More acidic, lower pH (5.0-5.5), more aluminum ions in soil – blue flowers
  - Less acidic, higher pH (6.0-6.5), fewer aluminum ions in soil – pink flowers
  - Purple- between the two pH




Professor Emeriti Reva A. Savkar

Aluminum Al is the most abundant metal in the Earth's crust by mass. It is the only element officially known by two names/spellings, aluminium by the International Union of Pure and Applied Chemistry (IUPAC), and aluminum by the American Chemical Society (ACS). It is decorative and functional, it does not corrode readily, and is used foil, cans, construction materials, packaging,, transportation, electronics, and paints and compounds used in common antacids





Fe 26  
55.845  
Iron

# Iron



- Iron Pillar, New Delhi, India
- 1600 Years Old and No Rust
  - Thin 1.2 mm protective layer of “misawite”, a compound of iron, oxygen and hydrogen, has protected the cast iron pillar from rust.
  - Biggest hand-forged block of iron from antiquity
- Serves as a guidepost for metallurgists in the 21st century

Professor Emeriti Reva A. Savkar

The Iron Pillar is 23 ft high, weighs more 6 tons, has a high phosphorus content. Some claim it was made in 900– 300 BCE . It is 98% pure wrought iron, regarded as good luck symbol if one can make one's hands meet behind it.

The Cape York meteorite collided with Earth nearly 10,000 years. Iron meteorites have held sacred appeal.

The Iron Age 1200 -500 BC. Proto-Inuit hunters used iron tools 1000 CE. It is believed that the meteorite was man's main source of iron.

Churchill coined the phrase the “Iron Curtain” to describe “inflexibility”

Margaret Thatcher was called the “Iron Lady” to symbolize strength, unbending.

A humorous association with word “iron”: the Duke of Wellington was called the “Iron Duke” because he put iron bars on his windows.

Mars the Red Planet: the Viking & the Pathfinder showed high iron minerals on surface, likely meteorite in origin.

Hemetite jewelry popular in the Victorian era had high iron content.

Hemoglobin in blood has red color due to iron, also responsible for the metallic taste of blood

# Mercury Fountain

Fundacio Joan Miro, Barcelona

Alexander Calder



Now Enclosed in Glass for Safety

Professor Emeriti Reva A. Savkar

The Mercury Fountain was created for the 1937 World's Fair, protesting Franco's siege of the Almadén mercury mines during the Spanish Civil War.

The term "mercurial" connotes changeable, volatile, erratic, like mercury in a thermometer that goes up and down to the slightest of influences, volatile in temperament.

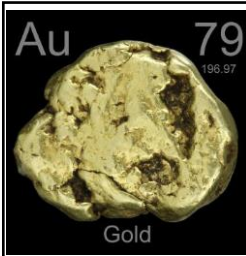
Characteristics of God Mercury - eloquence, ingenuity or mischievousness.

The Terracotta army in Xian is about 1 km away from where the Emperor Qin Shi Huang was buried in a bronze lined chamber with flowing channels of mercury symbolizing 100 rivers of China.

Mercury has been used in pigments, cosmetics, insecticides, syphilis treatment, laxatives, antiseptics-mercurochrome, dental amalgams.

Use of mercury has been banned in the European Union.

The character in the Alice in Wonderland book was called the Mad Hatter, because use of mercury in curing leather and felts to make hats, caused neuropathy and memory impairment



## Dreamers and Scientists Exploring the Seas for Gold

- Statue of a fashion model Kate Moss
  - Cult of Gold or Cult of Celebrity ?
- Samuel Clements, early American gold prospector, failed in his quest
  - Became the writer Mark Twain



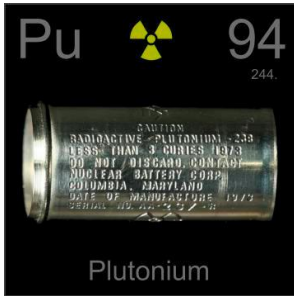
"Siren" sculpted in 50 kg solid 18 carat gold



Professor Emeriti Reva A. Savkar

The greatest accessible reserve is the ocean, seawater contains dissolved- 20 million tons of gold, 13 *billionths* of a g/L ocean water and undissolved solid on ocean floor. If extracted 9 pounds/person; 10 trillion dollars (US) worth. Recent evidence much of the earth's continental gold deposits have biological origins, certain bacteria, pedomicrobium, attract gold, build up layers, involved in pptn of gold out of hydrothermal solutions. Search for gold drove much of the European expansion into West. 'It's called Siren, because in a sense it represents everything that lures people to wreck themselves on the rocks: money, perfection, unattainable images – all these things.'-Quinn

'Gold certificates were used as paper currency from 1882 to 1933, freely convertible into gold coins. Gold standard test: considered definitive. Gold replaced by platinum-record sales more than gold, then used platinum, American Express elevated its highest credit card description to Platinum card!



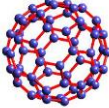

Nuclear Bombs and  
Nuclear weapons  
Long Lasting Batteries  
Power Apollo 14 Shuttle  
Heart Pacemakers

Professor Emeriti Reva A. Savkar

Plutonium was named after the dwarf planet Pluto, which was named after the Roman God of the underworld/dead. 1 kilogram of Plutonium can provide 22 million kilowatt hours of heat energy. Used to power seismic and other equipment on lunar surface. It is ironic that Martyn Poliakoff, the scientist working on weapons grade plutonium, worried about environmental effects of the chlorinated solvents used for removing grease from plutonium container. He investigated which Super Critical Solvents SCF could be used to make an "environmentally safe" i.e. a "green" atom bomb!

**Carbon**

Graphite, Diamond, Bucky Balls, Graphene




**“A key parallel between Science and the Arts: both strive for representation and expression, to capture some essential truth.**

*Clifford Johnson, Physicist,*

**“The form electrons took depended on how we looked at them: consequence of our observation. When it comes to atoms, language can be used only in poetry. Ordinary words couldn’t capture the data.”**

*Niels Bohr, Physicist*



Professor Emeriti Reva A. Savkar

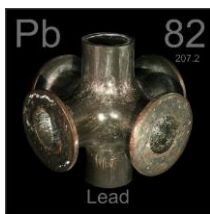
All are simply C atoms: Exotic, dazzling, the hardest are diamonds

Practical, hard working, the softest is graphite.

The fullerenes are intriguing

And their newest sibling 2-D graphene for which the 2010 Nobel Prize in Physics was awarded. It is the thinnest material, it is only one atom thick, one gram could cover a whole football pitch. It's the strongest material, very flexible and a good electrical conductor.

Brian Cox, British particle physicist, OBE, BBC presenter, Pop music keyboard player called 2-D graphene a material that has the potential to revolutionize the 21st century.



Lead

### World War II Submarine



Day camouflage: White lead oxide paint  
Daylight: White lead sulfate formed when washed with Hydrogen peroxide solution

Night camouflage: Black lead sulfide formed when washed with sea water containing sulfides

Professor Emeriti Reva A. Savkar

Plumbum, the Latin name for Lead, is the origin of the words “plumblin” “plumbers”, “plumbing” because lead has been for thousands of years for lead pipes, paints, drinking ware, storage ware. They were poisoning themselves in the process, although the modern understanding of the small amount of lead necessary to cause harm did not come about until the latter half of the 20th century. There is no safe threshold. Leslie Cromby, chemist WW II developed process for making lead based paint used for safe landing and getaway of submarines.





More than ten elements,  
including Strontium, have  
been discovered in the UK

Only one named for a place in UK

Scottish village called Strontian

Hazards: 1950s and 60s atmospheric  
nuclear testing produced radioactive  
strontium-90

1986 Chernobyl accident released  
radioactive strontium-90

2011 Fukushima nuclear plant disaster

Professor Emeriti Reva A. Savkar

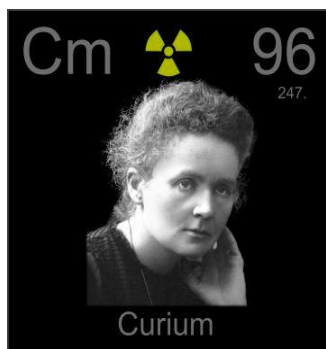
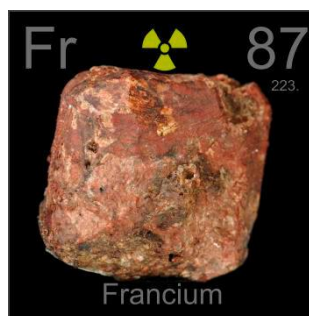


Strontium Sr-90 is radioactive, emits  $\beta$  particle. In 1986 radioactive strontium showed up in Denmark in higher levels in dairy products from cows grazing on contaminated meadows. This immediately alerted scientists about the Chernobyl accident days before any information was obtained from the then Soviet Union. Strontium gets incorporated into bones similar to calcium- radioactive strontium is linked to bone cancer, cancer of the soft tissue near the bone, and leukemia.

But other isotopes of strontium that are not radioactive are used in prevention and treatment of osteoporosis and osteo arthritis

Francium is the last element discovered in nature. In 1939 by Marguerite Perey, student and protege of Marie Curie.

It is highly radioactive, has a very short half-life used in research in atomic structure and biology



Curium named in honor of Marie and Pierre Curie was synthesized in 1944

Curium used in X-ray spectrometers in Sojourners and Mars Rovers

Professor Emeriti Reva A. Savkar

In 1962, Marguerite Perey was the first woman to be elected to the French [Académie des Sciences](#) an honor denied to her mentor Marie Curie. She named francium in honor of France.

## Europium discovered and named in 1901



The Ghostly light comes from special inks incorporated in Euro Notes to make them difficult to counterfeit: inks contain the element “Europium” bound in a complex with two acetone-like molecules.

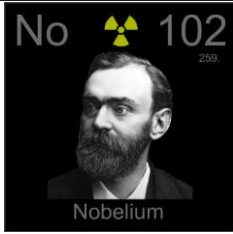
2000- Identical Euro Notes produced across the whole Eurozone

Obscure Europium has its Cultural Day almost a century after its discovery!



Professor Emeriti Reva A. Savkar

Europium is used to produce blue, red and white radiances in computer monitors and television screens, also used in energy efficient light bulbs.



## Nobelium

Industrial Chemist and Engineer

**Alfred Nobel discovered that Nitroglycerin when absorbed into *kieselguhr* became stable and safer: Dynamite**

Foundations of the Nobel Prize were laid in 1895 in his will, leaving much of his wealth for its establishment.

**Since 1901, the prize has honored women and men for outstanding achievements in physics, chemistry, medicine, literature and peace.**



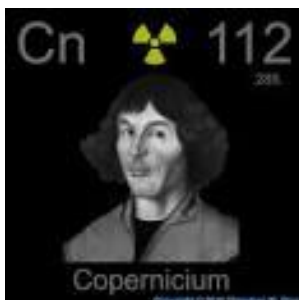
Monument to Alfred Bernhard Nobel in Wagga Wagga, New South Wales, Australia

Professor Emeriti Reva A. Savkar

In 1888, Alfred Nobel was astonished to read his own obituary, titled *The merchant of death is dead*, in a French newspaper. As it was Alfred's brother [Ludvig](#) who had died, the obituary was eight years premature. The article disconcerted Nobel and made him apprehensive about how he would be remembered. This inspired him to change his will to create the series of prizes, Nobel Prizes, for those who confer the "greatest benefit on mankind"

## Copernicium- in honor of Nicolaus Copernicus

Renaissance Astronomer & Mathematician  
Formulated Heliocentric Cosmology

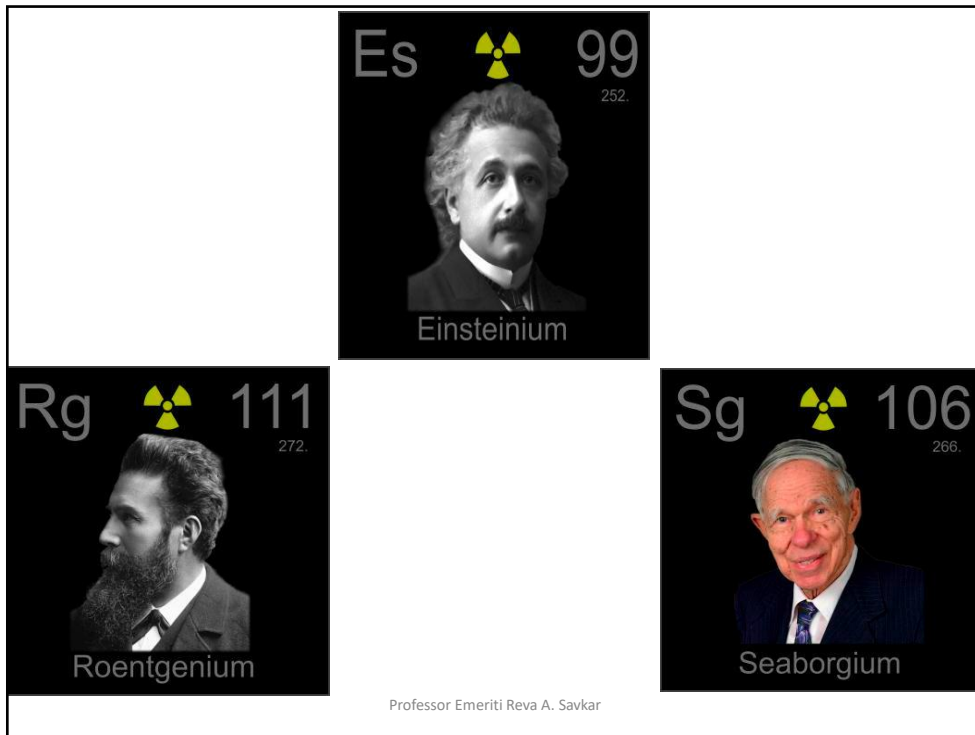


“Our imagination is stretched to the utmost, not, as in fiction, to imagine things which are not really there, but just to comprehend those things which are there.”

*Richard Feynman*

Professor Emeriti Reva A. Savkar

Nicolaus Copernicus formulated the Heliocentric Theory of the Universe, where Earth and other planets revolve around the Sun.



Three brilliant scientists: Seaborgium is the only element named after a scientist in his lifetime, Glenn Seaborg. He co-discovered 12 super heavy elements

Roentgenium: named for Roentgen, who discovered X-Rays, and received the first Nobel prize in Physics – the element is radioactive but does not emit X-Rays

Einsteinium: Named for the most famous scientist, but the element has a very short half-life and has no known applications

## Mass–Energy Equivalence



2006 Walk of Ideas, Berlin, Germany

Professor Emeriti Reva A. Savkar

Symbol- Probably the best known equation: This sculpture has taken on a colloquial meaning of its own -a symbol of harmony between all involved, interchangeability, inclusiveness, and an equation for all, without burden of the mathematical connotations. Most people feel comfortable quoting it, very likely they would not with another equation.



## [Song of the Elements](#)

Tom Lehrer

Professor Emeriti Reva A. Savkar



### Acknowledgements

- Hugh Aldersey-Williams
- Nobel Laureate Roald Hoffmann
- Periodic Table of Videos
- Photographic Periodic Table
- Northern Virginia Community College

Professor Emeriti Reva A. Savkar