THE DISCOVERY OF ELEMENTS

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SUPPORTED BY:
What are ELEMENTS?

PURE chemical substances having ONE type of ATOM

Examples: Hydrogen, Carbon, Iron, Gold, Oxygen, Calcium, Zinc, Copper, etc. (Which is the lightest?)

118 elements discovered until now, of which 94 occur naturally on our planet.

Did we always know all 118? Not really...
DMITRI MENDELEEV (1834 – 1907)

PERIODIC TABLE OF THE ELEMENTS

http://www.wikipedia.org
But first, some even older history...
Let us start at the very beginning: All elements are born in stars

Nucleosynthesis in stars
Fast forward to a few thousand years ago: The ANCIENT times
“Elements” in the Ancient World
India/Greece/..
The Ancients Knew Some Elements

Gold, Silver, Copper, Carbon, Sulphur, Mercury, Tin, Lead, Iron,

Known to Greeks, Romans, Egyptians/Middle East, Chinese, Indians
CARBON – LIFE IS CARBON-BASED

THE CHEMISTRY OF CARBON-CARBON BONDS
Chemists want to control making/breaking C-C bonds
Many NOBEL PRIZES for learning to make/break C-C bonds
Nobel prize – MOST prestigious science prize

POLYMERS – from C-C bonds
PROTEINS, DNA are polymers

SYNTHETIC POLYMERS
Polythene
Nylon
Rubber
POLYACRYLIC ACID: Gelation

DEMONSTRATION:
Gelation
CARBON COMPOUNDS/CO$_2$

Oil: The starting point for polymers

Why I chose to get into science...

CO$_2$: Problems due to our extreme reliance on carbon based fossil fuels
Fast forward from ancient times to a few hundred years ago: The MEDIEVAL times
Fast Forward to the MEDIEVAL AGE in Europe

SEARCH FOR:
PHILOSOPHER’S STONE

Convert metals into GOLD

ELIXIR of LIFE

http://www.wikipedia.org
PHOSPHOROUS (P)

Henning Brand, Hamburg, Germany
1669

White phosphorous is DANGEROUS
Volatile, Toxic (Phossy Jaw)
Highly inflammable

http://www.wikipedia.org
White $P_4$ – Video
Red $P_4$ – Safety Matches

Red phosphorous + powdered glass

Potassium chlorate + binder

http://www.wikipedia.org
RED PHOSPHOROUS: The Match Experiment

Demonstration
Discovery of ELEMENTS
Discovery of ELEMENTS

Chronology of the Discovery of the Elements

- Elements known to the ancients: C, Cu, Au, Fe, Pb, Hg, Ag, S, Sn
- Before 1700: As, Sb, Bi, P, Zn
- 1750 - 1950:
  - Electrochemistry
  - Spectral analysis
  - Nuclear reactions
  - Neutron bombardment

THE ERA OF ELECTROCHEMISTRY

In 1800, Volta invented the BATTERY

1.5 VOLT battery

Humphrey Davy discovered 5 elements (1807 – 1808): Strontium, Magnesium, Boron, Calcium, Barium

Davy’s father was a woor carver. Davy came from a modest background, but attended school and taught himself philosophy, science and poetry.

Became the most famous chemist in UK

Humphry Davy, UK
Humphry Davy: Demonstrations
DEMONSTRATION

Electrolysis
Magnesium
DEMONSTRATION

Mg burning
THE ERA OF ELECTROCHEMISTRY

Henri Moissan, Switzerland

USED ELECTROLYSIS OF HF (ACID) TO GET FLUORINE

PRIZE OF 10000 SWISS FRANCS WHEN HE COULD REPRODUCE THIS WORK (POTASSIUM FLUORIDE IMPURITY WAS REQUIRED)

1906 NOBEL PRIZE IN CHEMISTRY (MENDELEEV WAS NOMINATED BUT DIDN’T GET IT)
SPECTROSCOPY

Kirchhoff: Physicist, Laws for electrical circuits

Bunsen: Chemist

Shine light through intense, hot, nonluminous flame. Analyze the SPECTRUM

Identified Cesium and Rubidium

http://www.wikipedia.org
SPECTROSCOPY – FLAME TEST

DEMONSTRATION:
Flame Test
RARE EARTH

Are not really RARE

Exist in high concentrations in the earth’s crust

Difficult to mine

VERY IMPORTANT APPLICATIONS
Neodymium; Samarium: POWERFUL MAGNETS (ELECTRONICS, COMPUTERS, MOTORS/GENERATORS), LASERS
Yttrium: MICROWAVE RESONATORS
PHOSPHORS for TV SCREENS, SUPERCONDUCTORS

Today, CHINA produces 95% of all RARE EARTH MINERALS
Demonstration

Magnetic Braking
NATURAL RADIOACTIVITY

Unstable nuclei emit light or particles (like alpha particles, electrons) and rearrange to form a less excited state.

Fission/ Fissile break up is the basis of nuclear power/weapons.
MARIE CURIE

Nobel Prize in Physics – 1903
Becquerel, Pierre and Marie Curie
Research on “radiation phenomena”

Nobel Prize in Chemistry – 1911 (IYC:2011 in honour of this)
Discovery of radium and polonium

Could not find a position at Krakow University in Poland
Did not get elected to the French Academy of Sciences

Marie Curie grew up poor, but was well educated. Her father was a teacher of mathematics and physics in Poland.

http://www.wikipedia.org
ARTIFICIALLY-MADE ELEMENTS

Discovered 10 new elements
1951 Nobel Prize in Chemistry

Glenn T. Seaborg, USA
THE LATEST ELEMENT: 117
RESOURCES

http://chemistry.about.com/od/elementfacts/a/timeline-element-discovery.htm
http://education.jlab.org/qa/discover_ele.html
http://www.rsc.org/education/teachers/learnnet/periodictable/pre16/discover.doc
http://elements.vanderkrogt.net/
http://www.webelements.com/
http://en.wikipedia.org/wiki/Periodic_table
http://www.rsc.org/chemsoc/visualelements/pages/etable_fla.htm
http://www.chemheritage.org/
http://www.aip.org/history/curie/periodic.htm
VIDEOS from: http://www.youtube.com and http://arvindguptatoys.com
117 video from the Livermore Lab, taken from www.youtube.com

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