

QUICK SIX

A FAST-PACED CARD GAME ABOUT THE ELEMENTS

You will need: Scissors, photocopies of the pattern pages printed onto card stock

TIP: If you will be making multiple copies for a large classroom, consider making each set a different color. If you can't do this, then be careful to mark each set somehow, even if it is just a colored dot on the back. You will be glad you did this when the sets get all mixed up by the end of the class.

NOTE: Unfortunately, 118 divided by 9 leaves remainder 1. That means 1 card was doomed to be on the last page by itself. It is printed here on the instructions page, leaving the decision in your hands whether to include it in the game or not. If you'd like to use it, just copy this page onto card stock along with the other pattern pages.

Set up:

Cut apart the cards, then shuffle them thoroughly.

How to play:

- 1) The object of the game is to be the first player to collect six cards.
- 2) Decide which player will be the "caller." This player must read from the list below instead of being one of the card players. If an adult is supervising the game, this is the obvious adult job. An adult caller may want to choose particular attributes from the list below to emphasize facts recently learned. It is easiest to go down the list in order, but the caller need not go in order, and may also use items from the list more than once. Feel free to add your own ideas and write additional clues.
- 3) Each card player receives five cards, which he places face up in front of him. The rest of the cards go face down in a draw pile. The caller reads the first clue. Each player looks at their five cards to see if they have a card that matches the clue. If they do, they slap their hand down on the card. The caller looks to see who is the first player to slap their hand down. That player then shows the card under their hand. If the caller agrees that this card qualifies, then the player may remove that card from their line-up and put it face down into a "keeper" pile. Then they draw a card from the draw pile to replace that card, giving them five face-up cards once again.
- 4) The caller then reads off another clue from the list and the game continues in this manner until one player has six cards in their "keeper" pile.
- 5) If no player has a card that qualifies for a certain clue, the caller simply goes on to the next clue.
- 6) If you reach the end of the list, just start over at the beginning.
- 7) One round takes 5-20 minutes to play. You can switch callers between rounds if you want to.

NOTE: Some of these clues require the students to look at the atomic weight, or "mass," of the element. (Weight and mass are not really the same thing, but in this case the words can be used interchangeably. Kids seem to prefer "weight" to "mass.") The atomic mass is listed in smaller print right under the atomic number. It is basically the number of protons and neutrons added together. Electrons are so small they add almost nothing to the total mass. The reason that some of the masses are decimal numbers is that scientists measured many atoms, then took a mathematical average. Since a small percentage of atoms have one or two more (or less) neutrons, the average comes out to a decimal number. For example, if you weigh ten atoms of neon and get these results: 20, 20, 20, 20, 20, 20, 20, 20, 21, 21. The average is 20.2, so this is the atomic mass listed for neon. Most neon atoms have 10 protons and 10 neutrons, but once in a while you will meet a neon atom with 10 protons 11 neutrons.

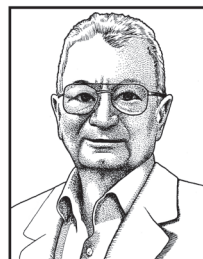
Og

118

Oganesson

294

named after Yuri Oganessian



- Yuri Oganessian pioneered many new chemistry techniques (at JINR) used to manufacture super-heavy elements.
- No commercial use.

QUICK SIX CLUES

The clues are in groups of ten just to make them easier to read (so you don't lose your place so easily).

Number has a 3 in it
Name has two syllables
Used in lasers
Has something to do with the color green
Named after Scandinavia, or a place in Scandinavia
Has something to do with teeth
Starts with the letter C
Number has a 5 in it
Name has something to do with color
Used to make tools of some kind

Is named after a city (not a country)
Name has three syllables
Is used to make jewelry
Named after a country
Used for something that burns
Named after something in the solar system
Number has a 7 in it
Is named after a country (not a city)
Used in fireworks
Has something to do with bones

Name starts with a vowel
Is found in gemstones
Used in steel production
Used to repair the human body
Used in light bulbs
Is found as a gas in the air around us
Has something to do with eyes
Conducts electricity
Last three letters of the name are I-U-M
Name is from a Latin word

Is used in batteries or fuel
Has something to do with glass
First letter of name does not match first letter of the symbol
Is found in some kind of gemstone
Name begins with the letter S
Name comes from a chemical compound
Name starts with the "K" sound (C or K)
Is used in magnets of any kind
Used in something that makes light
Has been used to make coins

Contains one of these letters: X, Y, or Z
Name has four syllables
Number has a 1 in it
Does not bond with any other element
Found in some kind of First Aid product (antiseptics, bandages, etc)

Quick Six clues page 2

Name comes from a mineral or chemical compound
Has an atomic number less than that of tin
Has the word "light" or "lights" in the description
Name ends with -ine
Has an atomic number between 50 and 60

Atomic number has a 3 in it
Name has two syllables
Used in hygiene product
Has something to do with the color green
Named after someplace in Scandinavia
Has something to do with teeth
Named after a Greek god or goddess
Is a transition metal
Starts with the letter C
Is in the same row as gold on the Periodic Table

Used in some kind of engine
Atomic number has a 5 in it
Used to make tools of some kind
Is named after a city (not a country)
Is an alkali earth metal
Is radioactive
Name has three syllables
Is used to make jewelry
Used for something that burns
Is a non-metal

Atomic mass is less than 30
Named after something in the solar system
Atomic number has a 7 in it
Is on the edge of the Periodic Table
Atomic mass is between 50 and 70
Named after Ytterby, Sweden
Is a true metal or semi-metal
Is named after a country (not a city)
Used in fireworks
Atomic number has three digits

Can be extracted from monazite sands
Is in the actinide series
Has something to do with bones
Name starts with a vowel
Is in the same row as molybdenum on the Periodic Table
Gemstones are made from it
Named after a famous scientist
Has an atomic number greater than that of tungsten
Used to color glass
Name has four syllables

Quick Six clues page 3

Atomic number has a 0 in it
Used in steel production or in bronze or copper
Used to repair the human body in some way
Is in the same column as helium on the Periodic Table
Used in light bulbs
Atomic mass is greater than 100
Is found as a gas in the air around us
Has something to do with eyes
Atomic number has a 9 in it
Is in the lanthanide series

Conducts electricity
Last three letters of the name are I U M
Is in the same row as iron on the Periodic Table
Has no commercial use
Is made in nuclear reactors
Name is from a Latin word
First letter of name does not match first letter of the symbol
The atomic mass listed on the card is exactly double the atomic number
Name comes from a Greek word or words
Used in anything with a screen-- televisions, computers, phones

Is in the third row of the periodic table
Name starts with the letter *u*
Used for coins
Unstable; only exists for a short time
Used in catalytic converters
Has a *y* in its name
Is in the third column of the periodic table
Used in lights
Made in nuclear reactors
Name comes from a German word or words

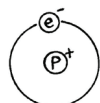
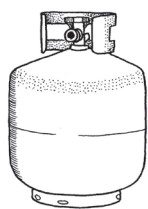
All the digits of the atomic number are the same
Used in batteries
Name has something to do with a color
The digits of its atomic number add up to 10
Used in magnets
Has an *x* in its name
Atomic number is a prime number
Name starts with the letter *m*
Exists for only seconds or minutes (elements beyond the actinide series)
Has more than 4 vowels in its name (*y* is a vowel)

Is in the first column of the periodic table
Name ends in “-on”
Name starts with the letter *s*
Has an atomic mass less than 10
Name has less than 5 letters
The sum of the atomic number and atomic mass is between 100 and 200

H

Hydrogen

Greek: "hydro-gen" (water-maker)

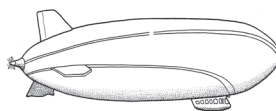


- Has no neutrons.
- Is the fuel for stars (including our sun)
- Used in rocket fuel and fuel cells
- Combines with O to make water.
- Combines with C to make natural gas.

He

Helium

Greek: "helios" (sun)



- Used in balloons, blimps and scuba diving tanks.
- Discovered in the sun in 1895 using a spectrometer.

Li

Lithium

Greek: "lithos" (stone)



- Used in batteries, lubricants, medicines, red fireworks, and nuclear bombs.
- Is never found by itself in nature, but is always in a compound.

Be

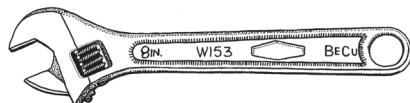
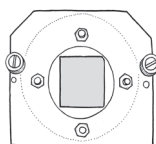
Beryllium

from the mineral "beryl"



4

9.0

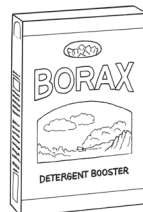


- Found in emeralds.
- Is mixed with copper to make "beryllium bronze," for making tools and parts that won't create sparks.
- Used for "windows" that let x-rays through.

B

Boron

from the compound "borax"

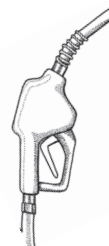


- Used to make heat-resistant glass.
- Used in boric acid antiseptic eye wash.
- Is a main ingredient in Borax® washing powder
- Used in nuclear power plants.
- Combines with white glue to make "slime."

C

Carbon

Latin: "carbo" (charcoal)



- Diamonds, graphite (pencil "lead") and coal are all made of carbon.
- Carbon makes long chains (polymers) that are the basis of fossil fuels and plastics.
- Carbon is necessary for organic molecules found in living organisms.

N

Nitrogen

Greek: "nitron" (the mineral saltpetre)



7

14.0



- Most of the air we breathe is nitrogen.
- Used in air bags in cars.
- Combines with H to make ammonia (found in some cleaning products)
- Plants need N to stay green.
- Found in gun powder.

O

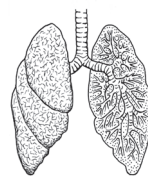
Oxygen

Greek: "oxy-gen" (acid-maker)



8

15.9



- Combines with silicon to make sand.
- Necessary for respiration and combustion.
- H₂O is water.
- H₂O₂ is hydrogen peroxide.

F

Fluorine

Latin: "fluere" (to flow)



- Combines with Ca to make fluorite.
- Is put into toothpaste to fight cavities.
- Combines with C to make Teflon.®
- Used as flux in steel making (makes hot metal flow better).

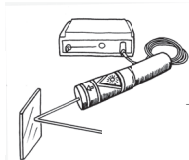
Ne

Neon

Greek: "neo" (new)

10

20.1



- Used in neon lights and lasers.
- Neon doesn't bond to other elements.

Na

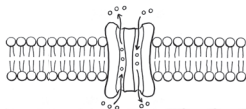
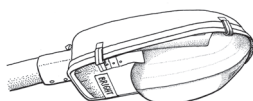
Sodium

from soda ash



11

22.9



- Combines with Cl to make table salt.
- Used in street lights.
- Found in bleach, NaClO.
- Found in sodium/potassium pumps in cell membranes.

Mg

Magnesium

from Magnesia, in Greece



12

24.3



- Used in white sparklers.
- Found in Epsom salt, $MgSO_4$.
- Is the central atom in chlorophyll (the green molecule in leaves).
- Used to make fire starters.

Al

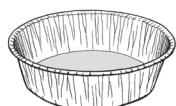
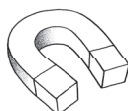
Aluminum

from the compound "alumina"



13

26.9

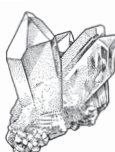


- Used to build bicycles and airplanes.
- Al_2O_3 is the mineral (gem) "corundum."
- Used for foil, and for beverage cans.
- Used in AlNiCo magnets.

Si

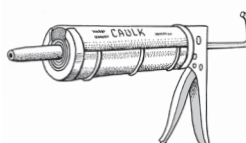
Silicon

Latin: "silex" (hard stone, boulder)



14

28.0

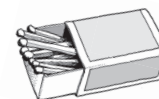


- SiO_2 is quartz, which can form sand.
- Used to make microchips.
- Used to make silicon rubber products like caulk and flexible baking dishes.

P

Phosphorus

Greek: "phosphoros" (bringer of light)



15

30.9

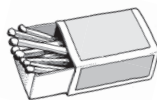


- Found in matches and some cleaners.
- Necessary for strong bones and teeth.
- Phosphoric acid is often in fizzy drinks.
- Is an ingredient in many plant fertilizers.

S

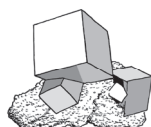
Sulfur

Latin: "sulfur" (stone that burns)



16

32.0

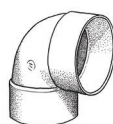


- Used to make matches.
- Used to vulcanize rubber.
- Volcanoes produce gases containing sulfur.
- Makes skunks and garlic stinky.
- Combines with Fe to make the mineral pyrite.

Cl

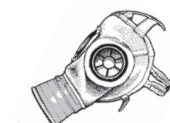
Chlorine

Greek: "kloros" (light green)



17

35.4



- Bonds with Na to make table salt.
- Used to disinfect swimming pools.
- Is an ingredient in PVC plastics.
- Found in bleach, NaClO.
- In pure form is a poisonous green gas.

Ar

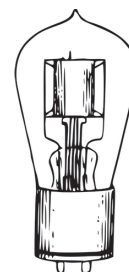
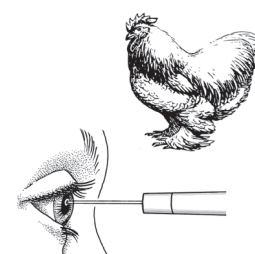
Argon

Greek: "argos" (lazy)



18

39.9



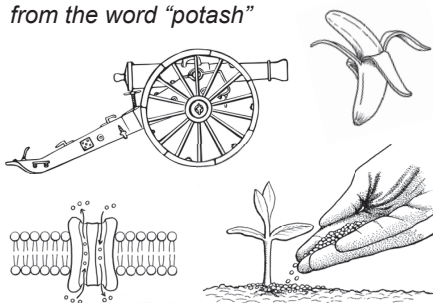
- Replaces air in lightbulbs.
- Used to make lasers for eye surgery.
- Used to butcher chickens.
- Doesn't form any molecules.

K 19

Potassium

39.0

from the word "potash"



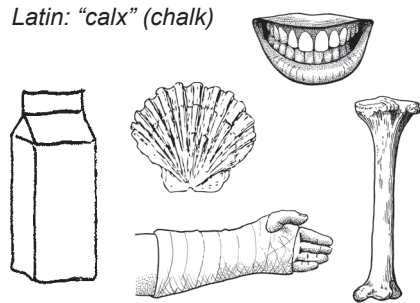
- Used in fertilizers.
- Is an ingredient in gun powder.
- Bananas contain a lot of potassium.
- Is found in mineral orthoclase feldspar.

Ca 20

Calcium

40.0

Latin: "calx" (chalk)



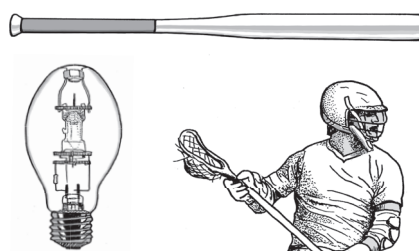
- Found in chalk, limestone and plaster.
- Needed for strong bones and teeth.
- Milk and broccoli have lots of calcium.
- Seashells are made with CaCO_3 .

Sc 21

Scandium

44.9

named after Scandinavia



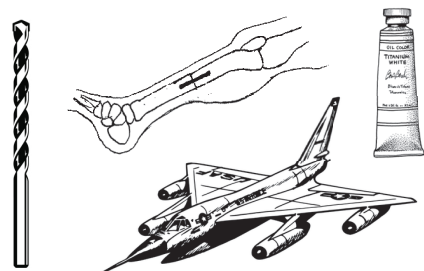
- Used in high intensity light bulbs.
- Used in large television screens.
- Alloys containing Sc are used to make sports equipment.

Ti 22

Titanium

47.9

named after the Greek Titan gods



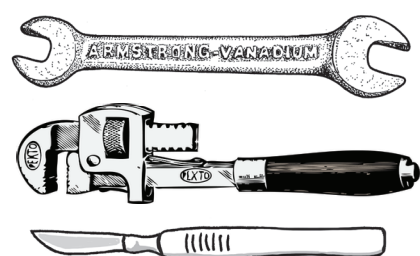
- Used to repair bones.
- Used to make white pigment for paint.
- Alloys are used to make airplane engines, drill bits and tools.

V 23

Vanadium

50.9

after the Scandinavian goddess Vanadis



- Added to steel to make very durable and corrosion-resistant tools, springs and engine parts.

Cr 24

Chromium

51.9

Greek: "chroma" (color)



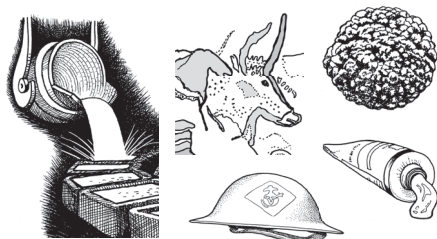
- Gives rubies their red color.
- Used to make red, green and yellow paint.
- Used as a shiny coating for metals.
- Added to steel to make it "stainless."

Mn 25

Manganese

54.9

Latin: "magnes" (magnetic)



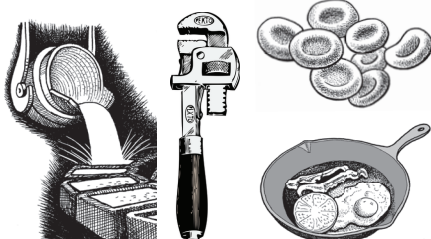
- Used to remove impurities from steel.
- Manganese nodules are on ocean floor.
- Found in vitamin B1.
- Is the "Mn" in YInMn blue pigment.
- Found in pigments in cave paintings.

Fe 26

Iron

55.8

from Old English "iren"



- Discovered in ancient times.
- Used in steel and in magnets.
- Fe will rust if O_2 and H_2O are present.
- Used to make cast iron cooking pans.
- Red blood cells are red due to iron.

Co 27

Cobalt

58.9

German "kobald" (evil gnomes)



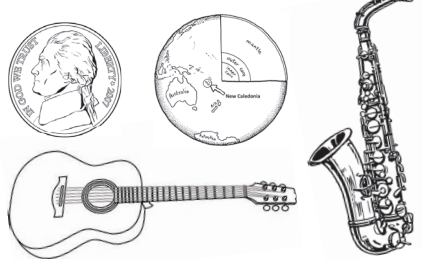
- Used in AlNiCo magnets.
- Used in making drill bits and razors.
- Can be used to color glass deep blue, or to make blue glaze/paint for pottery.
- Found in vitamin B12 (cobalamin).

Ni 28

Nickel

58.7

German: "Nickel" (Satan)



- Core of earth likely made of Ni and Fe.
- Used to make coins and utensils.
- Used as coating for keys of musical
- Used to make AlNiCo magnets.
- Guitar strings are made of nickel and steel.

Cu 29

Copper

63.5

Latin: "Cuprum" (from Cyprus)



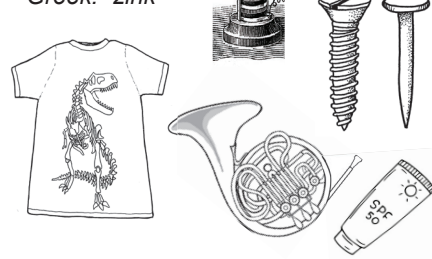
- Used for coins, wires and pipes.
- The Statue of Liberty is made of copper.
- Copper mixed with zinc makes brass.
- Copper mixed with tin makes bronze.

Zn 30

Zinc

65.4

Greek: "zink"



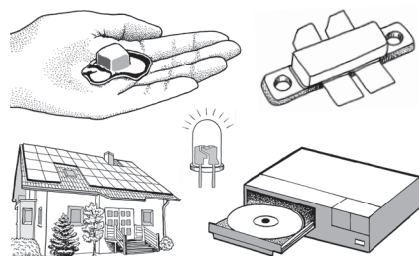
- Used for galvanizing (protecting) metal.
- Was used to make voltaic pile battery.
- Zinc sulfide glows in the dark.
- Zinc and copper make brass.
- Sunscreens can contain Zn compounds

Ga 31

Gallium

69.7

Latin: "Gallia" (France)



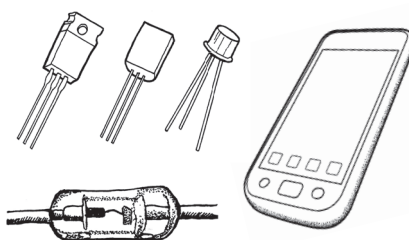
- Gallium arsenide is used in LEDs, lasers, and in Blu-ray players.
- Used in electronic devices.
- Gallium arsenide is in solar panels.

Ge 32

Germanium

72.6

Latin: "Germania" (Germany)



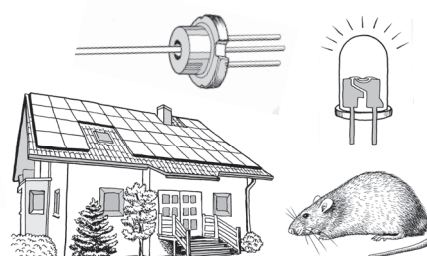
- Is a semi-conductor and therefore is used in transistors and diodes.
- Used in photographic lenses.
- Used in infrared-sensing devices.

As 33

Arsenic

74.9

Latin: "arsenicum" (a pigment)



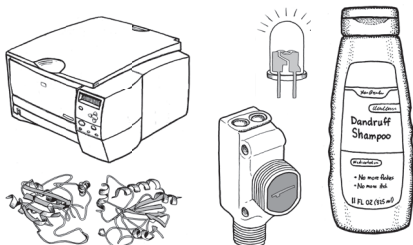
- Famous for its use as a poison.
- Gallium arsenide is in solar panels.
- Used in lasers and LED's.
- In the past, was used for green pigment.

Se 34

Selenium

78.9

Greek: "selene" (moon)



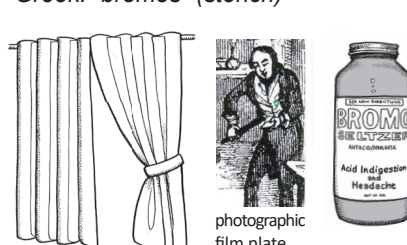
- Used in photocopiers because it conducts electricity in the presence of light.
- Used in solar panels and in light meters.
- Selenium used as an anti-oxidant in our bodies, protecting us from cellular damage.
- A key ingredient in anti-dandruff shampoo.

Br 35

Bromine

79.9

Greek: "bromos" (stench)



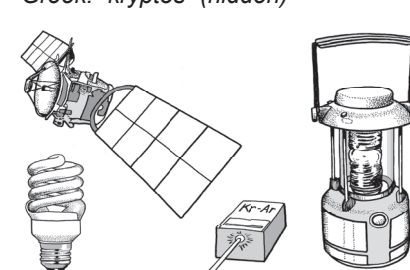
- Bromine is in the purple ink taken out of murex mollusks ("royal purple").
- Used to make fire-resistant fabrics.
- Was used in photographic film.
- Was key ingredient in Bromo-Seltzer.®

Kr 36

Krypton

83.8

Greek: "kryptos" (hidden)

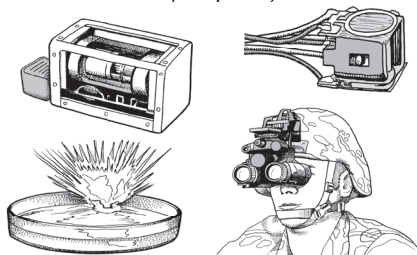


- Used in fluorescent bulbs, and for bulbs that need to be extremely bright.
- Used in UV lasers and in atomic clocks.
- Was used as propellant in satellites.

Rb 37

Rubidium 85.5

Latin: "rubidus" (deep red)

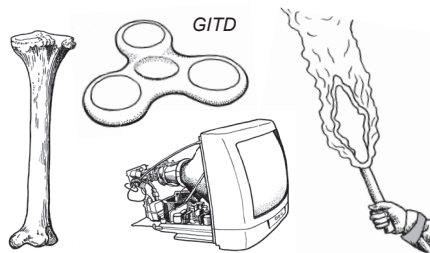


- Will burn in water (red flames).
- Used as a "scavenger" in vacuum tubes.
- Used in magnetometers and night vision goggles.
- Used in small atomic clocks.

Sr 38

Strontium 87.6

after the Scottish village of Strontia

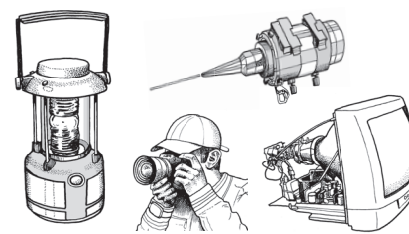


- Used in fireworks and flares.
- Sr in old bones is used by archaeologists.
- Was used in CRT television screens.
- Strontium aluminate glows in the dark.

Y 39

Yttrium 88.9

after the Swedish town of Ytterby

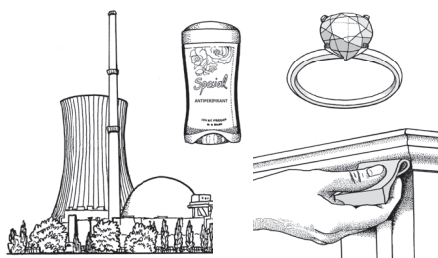


- Used in mantles for gas lanterns.
- Used in YAG (yttrium garnet) lasers.
- Made red color in CRT televisions.
- Is the "Y" in YInMn blue p
- Used in glass for specialty lenses.

Zr 40

Zirconium 91.2

Arabic: "zargun" (gold color)

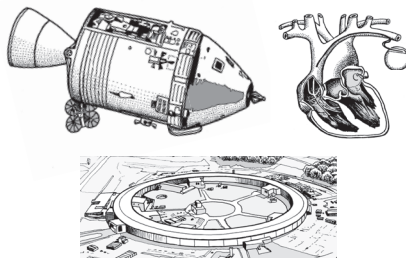


- Made into gemstones.
- Found in antiperspirants (along with Al)
- Used for tubes in nuclear power plants •
- Used to make abrasives (sand paper)

Nb 41

Niobium 92.9

named after the Greek goddess Niobe



- Used in welding rods and cutting tools.
- Used in alloys for rocket engines.
- Niobium jewelry is iridescent.
- Nb wired used in particle accelerators.

Mo 42

Molybdenum 95.9

Greek: "molybdos" (lead)

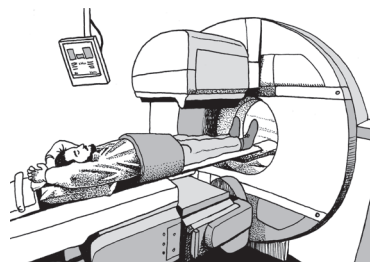


- Used for filaments in heaters.
- Added to steel ("Chromoly" steel) used for things that must be durable.
- Used in water quality gauges.
- MoS₂ is used as a dry lubricant.

Tc 43

Technetium 99.0

Greek: "teknetos" (artificial)

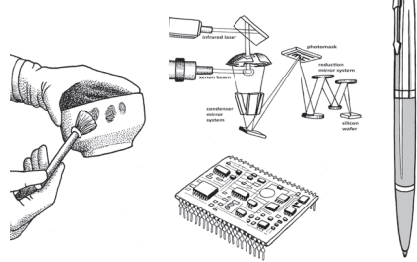


- Is radioactive.
- Not found in nature. Must be made in a nuclear lab, (usually from Mo or Ru).
- Used in medical procedures.

Ru 44

Ruthenium 101.1

Latin: "Ruthenia" (Russia)

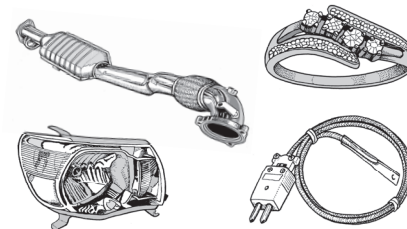


- Used to make resistor chips for electronic devices
- Was used to make tips for fountain pens.
- Used for lifting fingerprints.

Rh 45

Rhodium 102.9

Greek: "rhodon" (rose)

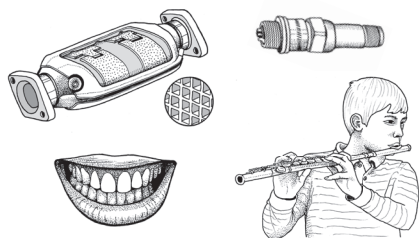


- Used in catalytic converters in cars.
- Used in headlight reflectors.
- Makes jewelry look extra shiny.
- Combined with **Pt** and **Pd** to make spark plugs and electrodes.

Pd 46

Palladium 106.4

named after the asteroid Pallas



- Used in catalytic converters in cars.
- Found in airplane spark plugs.
- Used to make high quality flutes.
- Used in jewelry and dentistry.
- Used with silver for capacitors.

Ag 47

Silver 107.8

Anglo-Saxon: "seolful" (silver)

Symbol from Latin "argentum"

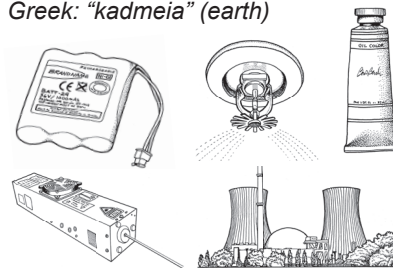


- Used to make coins, jewelry, mirrors, silverware, photographic film.
- Used to make anti-bacterial bandages.
- "Bang snaps" use silver fulminate.
- Used with palladium for capacitors.

Cd 48

Cadmium 112.4

Greek: "kadmeia" (earth)

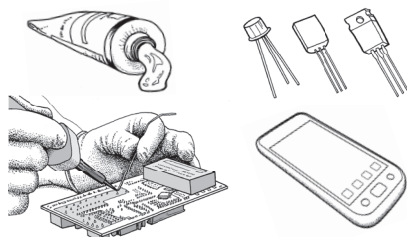


- Used in rechargeable batteries.
- Used in some lasers.
- Makes yellow and red pigments.
- Used (with Bi) for sprinkler fuses.
- Absorbs neutrons in nuclear reactors.

In 49

Indium 114.8

Latin: "indicum" (indigo blue)

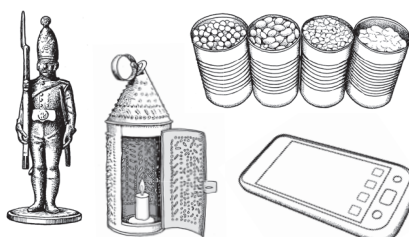


- Used in transistors and solar cells.
- Used in soldering.
- Indium-tin-oxide, ITO, is used as a conductive surface for touch screens.
- Is the "In" in YInMn blue pigment.

Sn 50

Tin 118.7

Latin: "stannum" (tin)



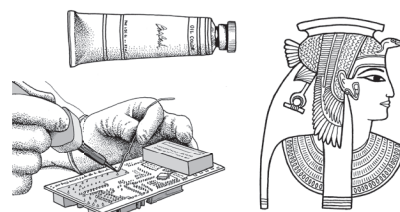
- Is an ingredient of pewter.
- Is mixed with copper to make bronze.
- Indium-tin-oxide, ITO, is used as a conductive surface for touch screens.
- Metal toys used to be made of tin.

Sb 51

Antimony 121.7

Greek: "anti-monos" (not alone)

Symbol comes from "stibnium"

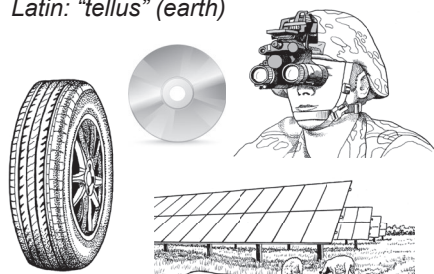


- Used in solder.
- Key ingredient in Naples yellow paint.
- Found in safety matches, and is added to fabrics to make them fire-resistant.
- Ancients used it in eye-liner cosmetics.

Te 52

Tellurium 127.6

Latin: "tellus" (earth)

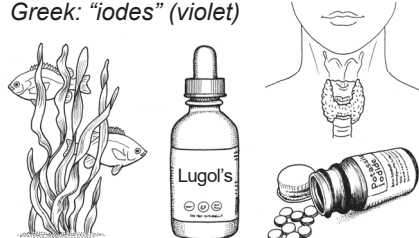


- Can replace sulfur in vulcanization process.
- HgCdTe is used to sense infrared, used in military night-vision equipment.
- CdTe is used in solar panels.
- Used to make Blu-ray discs.

I 53

Iodine 126.9

Greek: "iodes" (violet)

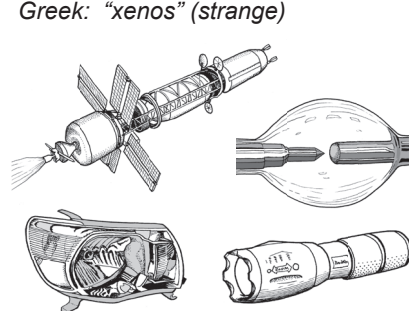


- Used as a disinfectant.
- Used in halogen lamps, ink pigments and photographic film.
- Our thyroid glands need iodine.
- Silver iodide is used to make clouds rain.
- Found naturally in seaweed.


Xe 54

Xenon 131.3

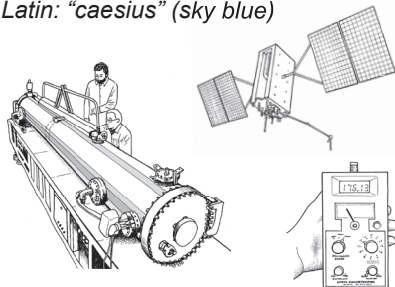
Greek: "xenos" (strange)



- Used in camera flash bulbs, strobe lights, and other high intensity bulbs.
- Was used as propellant for satellites.

Cs  **55**
Cesium **132.9**

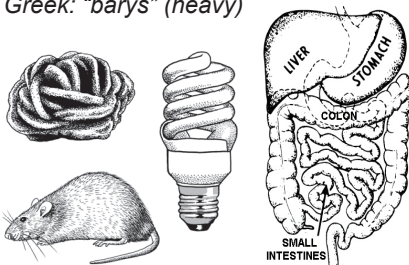
Latin: "caesius" (sky blue)



- Used in atomic clocks.
- Used as a "scavenger" (collector) inside vacuum tubes.
- Found in some magnetometers.

Ba  **56**
Barium **137.3**

Greek: "barys" (heavy)



- Used for X-rays of digestive systems.
- Used in fireworks (green color).
- Found in mineral barite (desert rose).
- BaO is in electrodes in fluorescent lights.
- Barium carbonate was used to kill rats.

La **57**
Lanthanum **138.9**

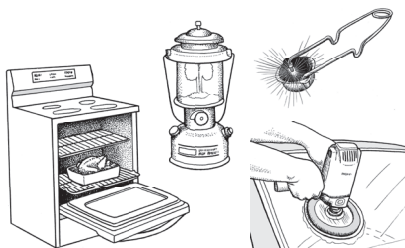
Greek: "lanthanein" (to lie hidden)



- Used in telescope and camera lenses.
- Used for electrodes in high intensity lights and in mantles for gas lanterns.
- Used in spark-making devices.
- Found in some algae-killing solutions.

Ce **58**
Cerium **140.1**

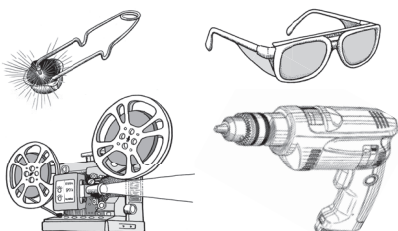
named after the asteroid Ceres



- Used in mantles for gas lanterns.
- Used in self-cleaning ovens.
- Used in sparking devices.
- Cerium oxide is used to polish glass.
- Extracted from monazite sand.

Pr **59**
Praseodymium **140.9**

Greek: "prasios-didymos" (green twin)



- Used in dymium glasses for welders.
- Used in bulbs for movie projectors.
- Used in magnets in electric tools.
- Sometimes found in sparking devices.
- Extracted from monazite sand.

Nd **60**
Neodymium **144.2**

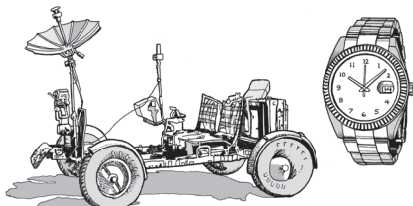
Greek: "neos-didymos" (new twin)



- Used in dymium glasses for welders.
- Used to make strong magnets found in headphones and other electronic devices.
- Used to color glass (blue, green, purple).
- Extracted from monazite sand.

Pm  **61**
Promethium **147.0**

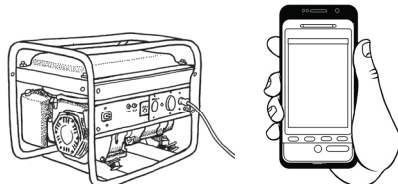
named after Greek god Prometheus



- Is a synthetic element made in nuclear reactors or cyclotrons.
- Was used to make glow-in-the-dark paint for the Apollo lunar rover.
- Replaced radium to make glowing paint for watches and clocks.

Sm **62**
Samarium **150.3**

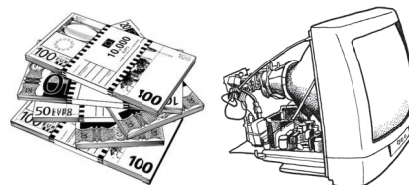
named after the mineral "samarskite" which was named for Col. Samarski, a Russian army engineer



- Used in magnets for MRI machines, computers and cell phones.
- Samarium-cobalt magnets found in heavy-duty generators.
- Extracted from monazite sand.

Eu  **63**
Europium **151.9**

named after Europe

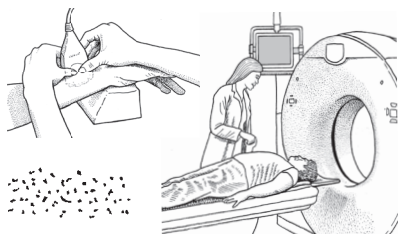


- Used to make red color in old CRT televisions.
- Used in fluorescent bulbs.
- Used to make fluorescent marks on Euros to prevent counterfeiting.
- Extracted from monazite sand.

Gd 64

Gadolinium 157.2

named for chemist Johann Gadolin

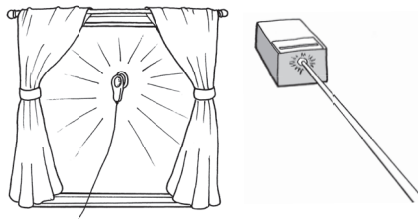


- Used in fluorescent bulbs (green light).
- Radioactive isotopes used in bone scans.
- Used as tracer in MRI scans.
- Extracted from monazite sand.

Tb 65

Terbium 158.9

named after Swedish village of Ytterby

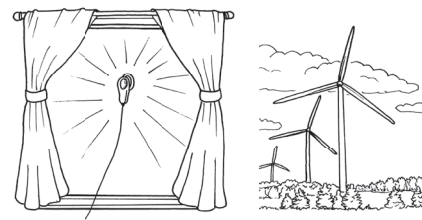


- Used to make Terfenol-D, which can turn any surface into a speaker.
- Used in fluorescent bulbs (glows green).
- Used in some green lasers.
- Extracted from monazite sand.

Dy 66

Dysprosium 162.5

Greek: "dysprositos" (difficult to obtain)

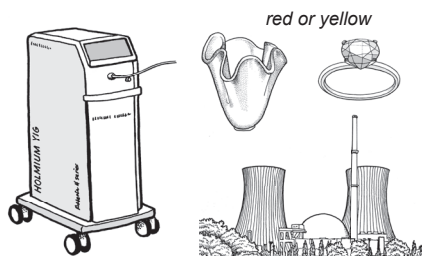


- Used to make Terfenol-D, which can turn any surface into a speaker.
- Used in wind generator magnets.
- Found in high intensity light bulbs.
- Extracted from monazite sand.

Ho 67

Holmium 164.9

named for Stockholm, Sweden

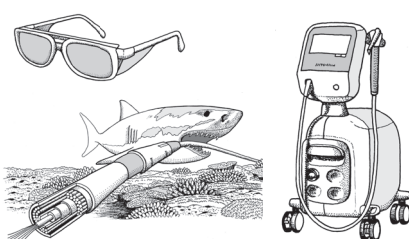


- Used in eye-safe medical lasers.
- Used to color glass red or yellow.
- Absorbs neutrons in nuclear reactors.
- Extracted from monazite sand.

Er 68

Erbium 167.3

named after Swedish village of Ytterby

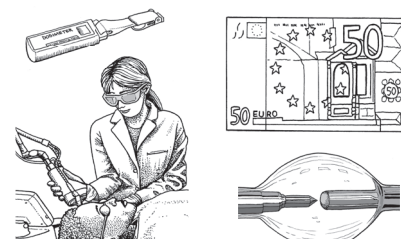


- Erbium glasses protect a patient's eyes during laser surgery.
- Used for coloring glass pink.
- Used to make medical lasers.
- Used to make relays in fiberoptic cables.

Tm 69

Thulium 168.9

Thule is the ancient name for Scandinavia

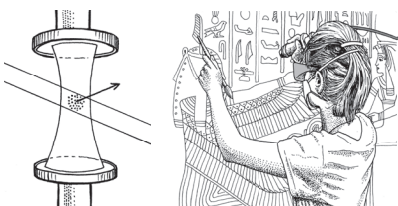


- Used in medical lasers.
- Makes fluorescent blue strip in Euro notes.
- Used in some radiation dosimeters.
- Used in some arc light bulbs.
- Extracted from monazite sand.

Yb 70

Ytterbium 173.0

named after Swedish village of Ytterby

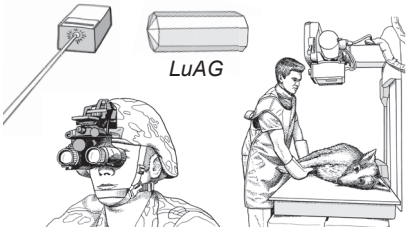


- Used in precision lasers that can clean ancient artifacts and famous paintings.
- Is added to steel to improve strength.
- Yb fluoride can be used in dental fillings.
- Yb atomic clocks use suspended atoms.
- Extracted from monazite sand.

Lu 71

Lutetium 174.9

Lutetia is the ancient name for Paris

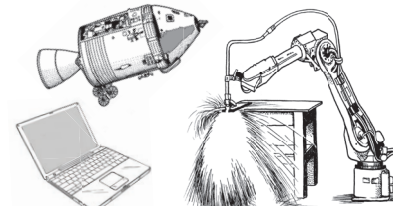


- LaTaO_4 is used in x-ray machines.
- Alloys of Lu are used to refine petroleum.
- Is the "Lu" in LuAG crystal lasers.
- Used in infrared sensing night-vision.
- Extracted from monazite sand.

Hf 72

Hafnium 178.5

Hafnia is the ancient name for Copenhagen

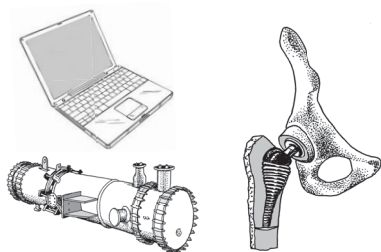


- Usually found with zirconium.
- Hf alloys were used to make nozzles of Apollo lunar module.
- Used for metal tips on plasma cutters.
- Enabled a critical step in learning to make smaller computer chips.

Ta 73

Tantalum 180.9

named after the Greek god Tantalus

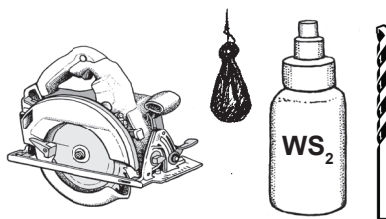


- Used in some artificial joints.
- Used to make pipes for heat exchangers (such as the large one shown here).
- Used for capacitors in electronics.

W 74

Tungsten 183.8

*Swedish: "Tung sten" (heavy stone)
Used to be called Wolframite*

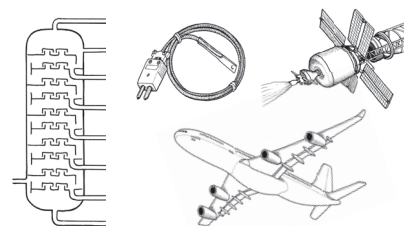


- Used for filaments in incandescent bulbs.
- Used to make drill bits and saw blades.
- Highest melting point of all the metals.
- Tungsten sulfide used as dry lubricant.
- Used as lead (Pb) substitute.

Re 75

Rhenium 186.2

Latin: "Rhenus" (Rhine River)

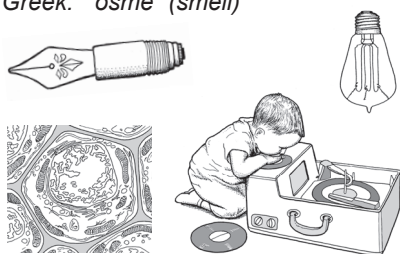


- Used in electrical switches.
- Used for thermocouples, high-temp thermometers, and oven filaments.
- Used in petroleum refining process.
- Re-W alloys used for jet engines.

Os 76

Osmium 190.2

Greek: "osme" (smell)

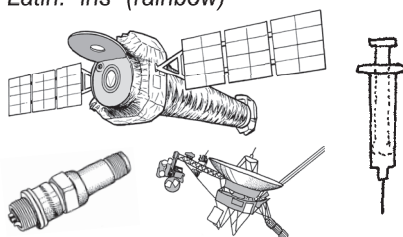


- Was used to make fountain pen points.
- Was used for the first phonograph needles.
- Used for staining microscopic samples.
- Is the most dense element.
- Was used in early light bulbs.

Ir 77

Iridium 192.2

Latin: "iris" (rainbow)

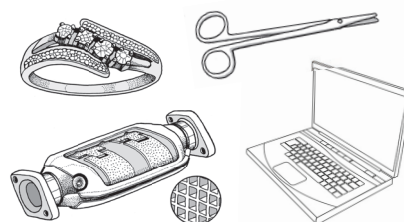


- Was used to make the mirrors for the Chandra X-ray observatory.
- Used in airplane/helicopter spark plugs.
- Used to make hypodermic needles.
- Satellites can be powered by plutonium that is housed in iridium containers.

Pt 78

Platinum 195.1

Spanish: "platina" (silver)

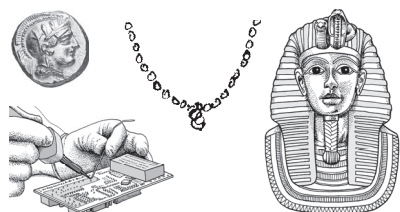


- Used in jewelry and dentistry.
- Used in computers and other devices.
- Used in catalytic converters for cars.
- Pt alloys are used to make corrosion-resistant tools.

Au 79

Gold 196.9

*Old English: "gold"
"Au" comes from Latin: "aurum"*



- Used for coins and jewelry.
- Used to make electrical circuits.
- Ancient artifacts often contain gold.
- Used as a reflective coating on the outside of large glass windows.

Hg 80

Mercury 200.6

named after the Roman god Mercury

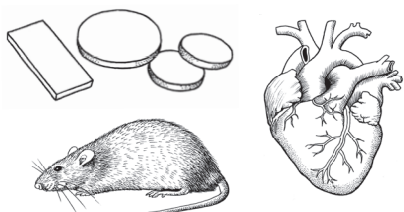


- The symbol **Hg** comes from the Latin "hydragyrum" meaning "liquid silver."
- Used in thermometers, barometers, street lights, and fluorescent bulbs.
- Was used by hat-makers in the 1800s.

Tl 81

Thallium 204.4

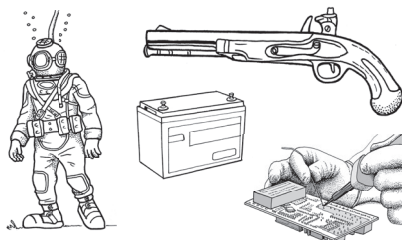
Greek: "thallos" (green twig)




- Looks like lead and is poisonous.
- Was once used to kill pests.
- Used to diagnose heart disease.
- Used in some automatic outdoor lights.
- Used in specialty lenses.

Pb  **82**
Lead **207.2**

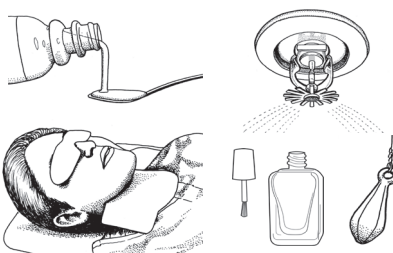
Ancient Anglo-Saxon: "lead"
 "Pb" comes from Latin: "Plumbum"



- Was used for fishing/diving weights.
- Was used to make "shot" (bullets).
- Still used in batteries for cars and boats.
- Has been used in soldering.

Bi  **83**
Bismuth **208.9**

German "weisse masse" (white mass)



- Used in pink, liquid stomach medicines.
- Used in indoor sprinkler systems.
- Used as lead replacement for sinkers.
- Used in shields protecting from x-rays.
- Found in iridescent nail polish.

Po  **84**
Polonium **210**

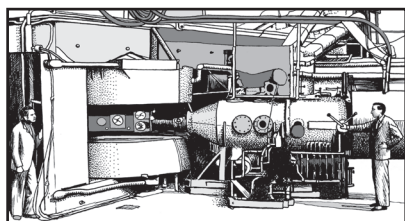
named after Poland



- Discovered by Marie Curie.
- Used in anti-static brushes.
- Radon from ground sticks to tobacco leaves, then decays into polonium, helping to make tobacco a carcinogen.

At  **85**
Astatine **210**

Greek: "astatos" (instable)



- Created in 1940 in the cyclotron at what is now Berkeley National Lab. They threw alpha particles (two protons and two neutrons) at bismuth atoms.
- No commercial applications.

Rn  **86**
Radon **222**

named after the element radium



- Is the heaviest gaseous element.
- Comes up out of the ground.
- Decays into polonium.
- Probably the result of uranium decay.

Fr  **87**
Francium **223**

named after France



- Discovered in France by Marguerite Perey, a student of Marie Curie.
- Comes from the decay of U and Th (in minerals pitchblende and uranite).
- Is too unstable to be used for anything.

Ra  **88**
Radium **226.0**

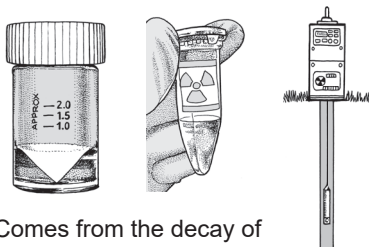
Latin: "radius" (ray)



- Discovered by Marie Curie.
- Was once used to make glowing clocks.
- Was used widely before it was discovered to be terribly dangerous.
- Now used to treat bone cancer because it will go to bones like calcium does.

Ac  **89**
Actinium **227**

Greek: "actinos" (ray or beam)



- Comes from the decay of uranium and thorium.
- One particular isotope is very useful in treating certain types of cancer.
- Shipped in V-shaped vials. Actinium atoms collect at point of V.

Th  **90**
Thorium **232**

after the ancient Scandinavian god Thor, god of lightning and thunder



- Was used for mantles for gas lanterns until found to be mildly radioactive.
- Was also used in welding electrodes and specialty lenses.
- One isotope is relatively stable.

Pa  **91**

Protactinium **231**

Greek: "protos" (first), plus "actinium"

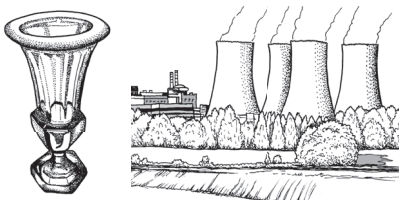
Pa \Rightarrow Ac

- Was given this name because it always decays into actinium. (Protactinium "comes first.")
- Found in nuclear waste.
- Levels of Pa and Th are studied in ocean sediments in order to learn about the history of the sediments.

U  **92**

Uranium **238**

named after the planet Uranus

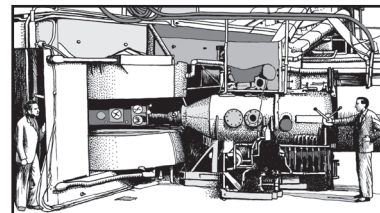


- Used as fuel in nuclear reactors.
- Depleted uranium (which is much less radioactive) is used to color glass yellow and to make metals for military vehicles.
- Primary ores: pitchblende, uranite.

Np  **93**

Neptunium **237**

named after the planet Neptune

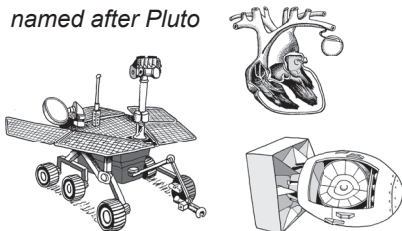


- Was manufactured in 1940 at what is now Berkeley National Lab.
- Is found in nuclear waste.
- Formation of Np from U is a step in the process of making weapons-grade Pu.

Pu  **94**

Plutonium **242**

named after Pluto



- Is made from uranium inside "breeder" nuclear reactors.
- Used in nuclear weapons.
- Was used to power the lunar modules. Now powers satellites and Mars rovers.
- Was used to power heart pacemakers.

Am **95**

Americium **243**

named after America

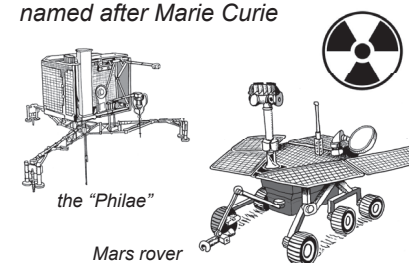


- Used in smoke detectors.
- Used in crystal research.
- Used as a source of neutrons in density gauges that search for underground water.
- Manufactured at Berkeley Lab in 1944.

Cm **96**

Curium **247**

named after Marie Curie

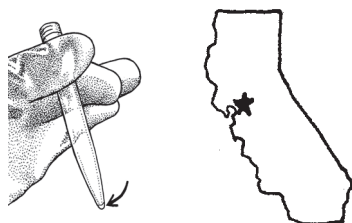


- Is used in devices that detect x-rays, and therefore can be found in the x-ray spectrometers on satellites and rovers. These devices can determine what elements are present in rocks and dirt.

Bk  **97**

Berkelium **247**

named after Berkeley, California



- Was made at Berkeley Lab in 1949.
- Only practical use is as a starting point for making even heavier elements.
- Like many super-heavy elements, it was discovered using a spectrometer.

Cf  **98**

Californium **251**

named after California

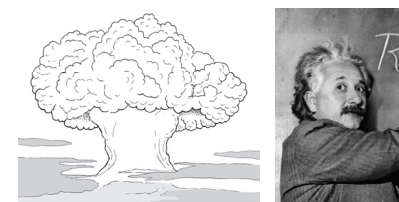


- Can be used as a portable source of neutrons in gauges that look for flaws in metal structures.
- Also used in devices that sense sources of underground water.

Es  **99**

Einsteinium **252**

named after Albert Einstein



- Discovered during the investigation of debris from the first atomic bomb.
- Einstein is famous for his equation that shows the relationship of matter to energy ($E=mc^2$).

Fm 100

Fermium 257

named after Enrico Fermi

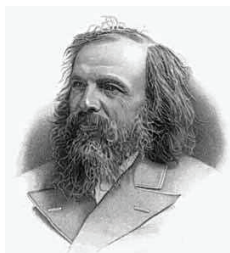


- Discovered during investigation of the debris from the first atomic bomb.
- No commercial use.
- Fermi was a physicist who studied atomic structure and radioactivity.

Md 101

Mendelevium 256

named after Dmitri Mendeleev

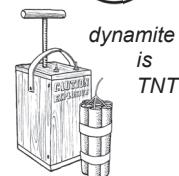


- Made in nuclear reactors.
- No commercial use.
- Mendeleev invented the Periodic Table.

No 102

Nobelium 259

named after Alfred Nobel



- Joint Institute of Nuclear Research in Dubna, Russia, given credit for discovery.
- No commercial use.
- Alfred Nobel established the Nobel Prizes using money from his invention of TNT

Lr 103

Lawrencium 262

named after Ernest O. Lawrence

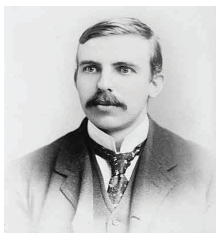


- Lawrence was the inventor of the cyclotron machine that was used to discover elements heavier than uranium.
- No commercial use.

Rf 104

Rutherfordium 261

named after Ernest Rutherford



- Rutherford figured out the structure of the atom. His "gold foil" experiment showed that atoms are mostly empty space.
- No commercial use.

Db 105

Dubnium 262

named after Dubna, Russia



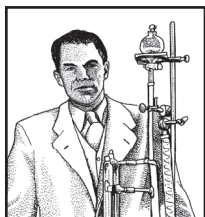
Joint Institute
of Nuclear
Research

- Was made in 1968 at the Joint Institute for Nuclear Research in Dubna, Russia.
- Also made in 1978 at the Berkeley Lab.
- Russia and US share credit for discovery.
- No commercial use.

Sg 106

Seaborgium 263

named after Glenn T. Seaborg

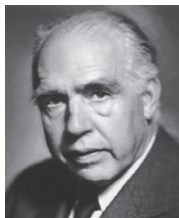


- Seaborg and his team at Berkeley Lab discovered Pu, Am, Cm, Bk, Cf, Es, Fm, Md and No.
- Is one of the few super-heavy elements that has been observed to form a molecule with other elements.

Bh 107

Bohrium 262

named after Niels Bohr



- Niels Bohr discovered electron energy levels (orbital and shells).
- The longest half-life is 40 seconds.
- No commercial use.

Hs 108

Hassium 265

named after German state of Hesse



- Named after the German state where the GIS Helmholtz Institute is located.
- Longest-lived isotope is 110 seconds.
- No commercial use.

Mt 109

Meitnerium 268

named after Lise Meitner

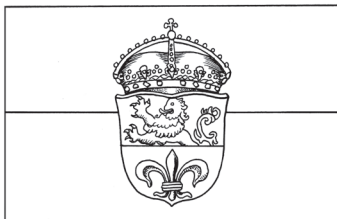


- Meitner worked with Otto Hahn (1930-40) to discover the process of fission in uranium atoms.
- No commercial use.

Ds 110

Darmstadtium 269

named after Darmstadt, Germany



- Discovered in 1994 at the GSI Helmholtz Institute in Darmstadt.
- No commercial use.

Rg 111

Roentgenium 272

named after Wilhelm Roentgen

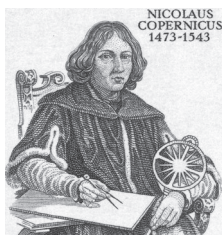


- Roentgen discovered x-rays.
- Is the heaviest member of the group (column) that contains copper, silver, gold.

Cn 112

Copernicium 277

named after Ernest O. Lawrence



- Is the only element named after a scientist who was not a chemist or physicist.
- Copernicus discovered that the earth goes around the sun.
- No commercial use.

Nh 113

Nihonium 284

named after Japan (Nihon)



- Several labs made this element but RIKEN lab in Japan was given official credit for discovery.
- No commercial use.

Fl 114

Flervorium 289

named after Georgy Flyorov



Joint Institute
of Nuclear
Research

- Georgy Flyorov was director of JINR Lab in Dubna for a number of years.
- Only 58 atoms have ever been made.
- No commercial use.

Mc 115

Moscovium 288

named after Moscow, Russia



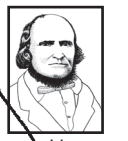
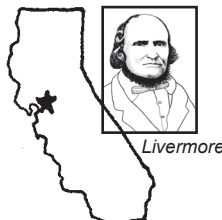
Joint Institute
of Nuclear
Research

- Was first manufactured in 2004 at the JINR, which is in the state of Moscow.
- Longest-lived isotope is 1/2 second.
- No commercial use.

Lv 116

Livermorium 292

named after Livermore, CA



Livermore



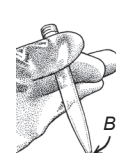
Lawrence

- Livermore, CA, got its name from its founder, Robert Livermore, a rancher.
- Lv was a collaborative effort of JINR and Lawrence Livermore National Lab.
- No commercial use.

Ts 117

Tennessine 294

named after state of Tennessee



- Manufacturing of Ts was a collaboration between JINR (Russia) and Lawrence Livermore National Lab (US).
- Made from Bk atoms that were made at Oak Ridge National Lab in Tennessee.
- No commercial use.