

EXPLORING MATTER:

An Interactive, Inexpensive Chemistry Exhibit for Museums

The Great Valley Museum's newest exhibit has been generously funded by two grants:

American Chemical Society Collaborative Opportunities Grant
Modesto Junior College Foundation Grant

The grants were awarded to Steven Murov (Professor Emeritus of Chemistry, Modesto Junior College), Dave Menshew (science instructor at Enochs High School), Enochs High School Science Students, Shane Phillips (Professor of Chemistry at CSUStanislaus), the El Concilio organization with Yamilette Villadolid and the Great Valley Museum with Director Arnold Chavez.

Collaborative Opportunities Grant Winners

The ACS Collaborative Opportunities Grants are designed for smaller activities that collaborators can use to provide momentum to true partnerships. The winners of these grants have shown exceptional ingenuity in developing projects with broad reach, engaged partners, and mutual benefits.

Exploring Matter is an interactive chemistry exhibit designed for the Great Valley Museum, focusing on the properties of matter with an emphasis on the elements. The exhibit is intended to stimulate interest in STEM fields in an underserved community.

The exhibit has 21 interactive stations that have been developed to enhance your understanding of matter and to stimulate your interest in science and chemistry.
Stations 1 - 12 - properties of matter with an emphasis on density,
Stations 13 - 15 - problem solving exercises with unusual observations,
Stations 16 - 20 - contemporary issues related to chemistry including reactions, nuclear issues, drug design and fossil fuel issues.

For web sites containing details for Stations 1 - 21, please see: <http://murov.info/EM-TOC.htm>

For more information on the Great Valley Museum and web sites that should be useful, please see:

<http://www.mjc.edu/instruction/sme/gvm/> (Great Valley Museum)

<http://murov.info/familyscience.htm> (Stanislaus County Science Directory)

<http://murov.info/chemhome.pdf> (Chemistry experiments that can be done at home)

<http://murov.info/scienceevents.htm> (Stanislaus County Science events)



GREAT VALLEY MUSEUM

Modesto Junior College West Campus, Science Community Center
2201 Blue Gum Avenue, Modesto, CA 95358 209 575-6196

Disneyland is the happiest place on earth.

The GVM is the family friendliest place in Modesto!



GVM 209 575-6196 <http://www.mjc.edu/instruction/sme/gvm/>

Museum hours Closed Sunday, Monday. Tue., Wed., Thurs., 12 pm – 4 pm, Fri., Sat., 9 am – 4 pm
GVM admission, \$3 - \$5, family up to 6, \$15 Free with GVM membership
planetarium \$4- \$6, reduced fee with membership

Special Events

1st Fri. Night of each month is Science Night at the Museum
9/24/16 “Wild Planet Day”, 10/21/16 “Dr. Alchemist & Mischiefs”



Tours

Science on Sphere



World class Planetarium



Worksheet for Stations 11 and 12

What are the names of the elements C, Mg, Al, S, Ti, Fe, Ni, Cu, Se, Sn, W and Pb?

Element symbol	Name	Density Lit. Val. (g/cm ³)	GVM density (g/cm ³)	GVM Rank	Color	Elect. Cond.	Magnetic Prop.
Mg	_____	1.74	1.70	1	silver	C	NF
C	_____	2.27	1.76	2	black	WC	NF
S	_____	2.07	1.89	3	yellow	NC	NF
Al	_____	2.70	2.71	4	silver	C	NF
Se	_____	4.79	4.20	5	gray	NC	NF
Ti	_____	4.51	4.48	6	silver	C	NF
Fe	_____	7.87	8.04	7	gray	C	F
Cu	_____	8.92	8.92	8	copper	C	NF
Ni	_____	8.91	9.04	9	gray	C	F
Pb	_____	11.34	11.39	10	slate gray	C	NF
W	_____	19.3	19.27	11	gray	C	NF

Unk. letter	Mass (grams)	Rank (1-11) (rel. density)	Elect. Cond.	Magnetic (ferro or not)	Color	Luster	Element Name
A	_____	_____	_____	_____	_____	_____	_____
B	_____	_____	_____	_____	_____	_____	_____
C	_____	_____	_____	_____	_____	_____	_____
D	_____	_____	_____	_____	_____	_____	_____
E	_____	_____	_____	_____	_____	_____	_____
F	_____	_____	_____	_____	_____	_____	_____
G	_____	_____	_____	_____	_____	_____	_____
H	_____	_____	_____	_____	_____	_____	_____
I	_____	_____	_____	_____	_____	_____	_____
J	_____	_____	_____	_____	_____	_____	_____
K	_____	_____	_____	_____	_____	_____	_____
For station 12							
X	_____	_____	_____	_____	_____	_____	_____

Density for X = mass/3.22 = _____ g/cm³

C = conductor	F = ferromagnetic
WC = semiconductor	NF = not ferromagnetic
NC = non-conductor	

PERIODIC TABLE OF THE ELEMENTS

The 11 Element ID Challenge

1		d										p						18
1A																		8A
1 NC H NF	2	KEYS C = electrical conductor WC = weak conductor NC = non-electrical cond. F = ferromagnetic NF = not ferromagnetic										13	14	15	16	17	2 NC He NF	
3 C Li 0.53 NF	4 2A Be 1.85 NF	Atomic # elect. cond. Element Symbol Density mag. prop.										5 NC B 2.34 NF	6 WC C 2.27 NF	7 NC N NF	8 NC O NF	9 NC F NF	10 NC Ne NF	
11 C Na 0.97 NF	12 C Mg 1.74 NF	3	4	5	6	7	8	9	10	11	12	13 C Al 2.70 NF	14 NC Si 2.33 NF	15 NC P 1.82 NF	16 NC S 2.07 NF	17 NC Cl NF	18 NC Ar NF	
19 C K 0.86 NF	20 C Ca 1.55 NF	21 Sc Sc 2.99 NF	22 C Ti 4.51 NF	23 V V 6.11 NF	24 Cr Cr 7.19 NF	25 C Mn 7.43 NF	26 C Fe 7.87 F	27 Co Co 8.86 F	28 C Ni 8.91 F	29 C Cu 8.92 NF	30 C Zn 7.13 NF	31 C Ga 5.91 NF	32 WC Ge 5.32 NF	33 C As 5.72 NF	34 NC Se 4.79 NF	35 NC Br 3.12 NF	36 NC Kr NF	
37 C Rb 1.63 NF	38 C Sr 2.54 NF	39 C Y 4.47 NF	40 C Zr 6.51 NF	41 C Nb 8.57 NF	42 Mo Mo 10.22 NF	43 C Tc 11.5 NF	44 C Ru 12.37 NF	45 C Rh 12.41 NF	46 C Pd 12.02 NF	47 C Ag 10.5 NF	48 C Cd 8.65 NF	49 C In 7.31 NF	50 C Sn 7.31 NF	51 C Sb 6.68 NF	52 WC Te 6.24 NF	53 NC I 4.93 NF	54 NC Xe NF	
55 C Cs 1.87 NF	56 C Ba 3.59 NF	57 C La 6.15 NF	72 C Hf 13.31 NF	73 Ta Ta 16.65 NF	74 C W 19.3 NF	75 Re Re 21.04 NF	76 C Os 22.6 NF	77 C Ir 22.4 NF	78 C Pt 21.45 NF	79 C Au 19.32 NF	80 C Hg 13.55 NF	81 C Tl 11.85 NF	82 C Pb 11.3 NF	83 C Bi 9.75 NF	84 C Po 9.32 NF	85 At At 7 NF	86 Rn Rn NF	
87 C Fr 1.87 NF	88 Ra Ra 5.5 NF	89 Ac Ac 10.07 NF	104 Rf Rf	105 Db Db	106 Sg Sg	107 Bh Bh	108 Hs Hs	109 Mt Mt	110 Ds Ds	111 Rg Rg	112 Cn Cn	113 Nh Nh	114 Fl Fl	115 Mc Mc	116 Lv Lv	117 Ts Ts	118 Og Og	
Colors of 11 Elements* black - C silver - Mg, Al, Ti gray - Fe, Se, W, Ni yellow - S copper - Cu slate gray - Pb *Station 11 elements		f																
		58 C Ce 6.77 NF	59 C Pr 6.77 NF	60 C Nd 7.01 F	61 C Pm 7.26 NF	62 C Sm 7.52 NF	63 C Eu 5.24 NF	64 C Gd 7.9 F	65 C Tb 8.23 NF	66 C Dy 8.55 F	67 C Ho 8.8 NF	68 C Er 9.07 M	69 C Tm 9.32 NF	70 C Yb 6.96 NF	71 C Lu 9.84 NF			
		90 C Th 11.72 NF	91 C Pa 15.4 NF	92 C U 18.95 NF	93 C Np 20.2 NF	94 C Pu 19.84 NF	95 Am Am 13.67 NF	96 Cm Cm 13.5 NF	97 Bk Bk 14.78 NF	98 Cf Cf 15.1 NF	99 Es Es	100 Fm Fm 8.84	101 Md Md	102 No No	103 Lr Lr			

key: italics - gas, shadow - liquid, bold or normal - solid, normal print - all known isotopes are radioactive.

Colored elements are the unknowns for this experiment. Distinguish using color, luster, relative density, electrical conductivity and magnetic attraction.

STATIONS

Description

- 1 States of Matter
- 2 The Drinking Bird
- 3 Liquid Crystals 1
- 4 Liquid Crystals 2
- 5 Substances: Elements and Compounds
- 6 Separation of Mixtures: Paper Chromatography
- 7 Mass Measurement and Perception
- 8 Mass of Pennies
- 9 Density Dependent Devices
- 10 Sink or Float Colas
- 11 The 11 Element ID Challenge
- 12 A 12th Element ID Challenge
- 13 The Microscopic World
- 14 Mysterious Stirring Device
- 15 Disappearing Test Tube
- 16 Chemical Reactions: Photochromism
- 17 Nuclear Stability and Radioactivity
- 18 Molecular Models of Small Molecules and Penicillins
- 19 Fossil Fuels and Climate Change
- 20 Thermal Imaging: Earth and Personal
- 21 Suggestion Box