

## ***Investigating Physical Properties*** **A Graphing Calculator Exercise**

This activity assumes the teacher provides students with a sample of chemical elements (table one). One of the elements is unlabeled and represents the 'Mystery Element'. These elements are solid pieces, typically stored in a paper/plastic cup. The students will use the solid pieces to determine the density of each element using a volume displacement technique. Each piece should be of sufficient to give a quality measurement.

While teacher notes are provided on the last page of this document, it is assumed that teachers work through the activity before consulting the answer key.

Table One

<u>Element Symbol</u>
Mg
Al
Si
Fe
Ni
Cu

Investigating Physical Properties  
Activity One  
Observation/Description

Your teacher will provide you with a sample of chemical elements. All of the elements in your sample are pure (they are not mixed with anything else). You are also provided with a mystery element for identification.

- Provide a brief physical description for each of your samples. Use your senses carefully and organize your descriptions in a data table.
- Do some of the materials appear to be made of the same material? If so, which ones?
- Find the position of your elements on the periodic table. Is there a pattern to their properties and their position on the table? Explain.
- Try to identify the mystery element by comparing its physical appearance with the other samples. Comment on your accuracy.

Physical properties such as color, luster, melting point, and hardness can be used to describe and identify a substance. Some properties make identification easier than other properties. Density is one such property.

The structure of the periodic table is based on the physical and chemical properties of the elements. Your task will be to use density combined with each element's atomic number to search for a trend in the periodic table.

*Density* is a physical property that is independent of the sample size (its always the same no matter how much stuff you have) and density can be used to identify a substance.

Construct a data table similar to the one below:

Sample	Atomic Number	Mass (g)	Volume (ml)	Density (g/ml)
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- Measure the mass of each metal piece in your sample.
- Determine the volume of each piece using *water displacement*. Add each metal piece to a known volume of water in a graduated cylinder and measure the new volume. The difference in volumes when the piece is added is the volume of the object. Be sure to add the piece slowly as to not splash water out of the cylinder).
- Calculate the density of each sample.
- Use a periodic table to look up the atomic number for each of the elements in your sample.
- Obtain a TI-82/83 graphing calculator. Clear any equations from the calculator and enter the atomic number and density data for your element samples into the STAT Editor.
- Construct a xyplot of the density vs. atomic number for your samples.
- Sketch the graph (remember to write in labels for the axis).
- Describe the pattern illustrated by your graph. Explain how the periodic table could be used to predict this pattern.

DIRECTIONS FOR TI-82/83

[Y=] Clear all equations  
[STAT] EDIT  
L1=Atomic Number  
L2=Density (g/ml)

[2nd] [Y=]  
Select Plot1  
Select ON  
Define the following:  
[Xlist=L2] [Ylist=L1] Mark: +  
[ZOOM]  
ZoomStat

1.0 Predict how the graph would change if you added data for elements with atomic number 1~23. Provide a sketch and justify your prediction.

- Clear the data from the calculator lists.

[STAT] EDIT  
Select list, press CLEAR

Investigating Physical Properties  
Activity Two  
Collecting Evidence

- Obtain a TI-82/83 graphing calculator. Clear any equations from the calculator and reconstruct your graph of density vs. atomic number for the elements in activity one.

Table One

Atomic Number	Element Symbol	Density (g/ml)
15	P	1.82
16	S	2.07
17	Cl	0.00321
18	Ar	0.00184
19	K	0.086
20	Ca	1.55
21	Sc	2.99
22	Ti	4.54
23	V	6.11

- Add the data in table one for atomic numbers 15-23 to your current graph by constructing a second xyplot of density vs. atomic number.

```

[STAT] EDIT
L3=Atomic Number (elements 15-23)
L2=Density (g/ml) (elements 15-23)
[2nd] [Y=]
Select Plot2
Select ON
Define the following:
[↵] Xlist=L3 Ylist=L4 Mark:
[ZOOM]
ZoomStat
    
```

- Sketch the graph (remember to write in labels for the axis).

- 2.1 Explain how your prediction compared with the actual data for elements 15-23.
- 2.2 Use your periodic table to provide an explanation for the new graph with elements 1-23 represented.
- 2.3 Predict the position of the point for the element tin on your graph of density vs. atomic number for elements 1-23.

Table two

Atomic Number	Element Symbol	Density (g/ml)
34	Sn	4.79

- Add the data in table two for the element tin to your current graph by constructing a third scatter plot of density vs. atomic number.

```

[STAT] EDIT
L5=Atomic Number
L6=Density (g/ml)
[2nd] [Y=]
Select Plot3
Select ON
Define the following:
[↵] Xlist=L5 Ylist=L6 Mark:
[ZOOM]
ZoomStat
    
```

- Sketch the graph (remember to write in labels for the graph).

- 2.4 Explain how your prediction compared with the actual data for tin.

- 2.5 Use your periodic table to provide an explanation for tin's location on the graph.

- Clear the data from the calculator lists.

```

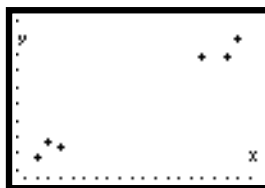
[STAT] EDIT
Select list, press CLEAR
    
```

# Teacher Notes

## Activity One

### Elements Used

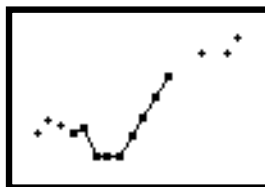
Atomic Number	Element Symbol	Density (g/ml)
12	Mg	1.738
13	Al	2.699
14	Si	2.330
26	Fe	7.860
28	Ni	7.860
29	Cu	8.960



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## Activity Two Part One

Atomic Number	Element Symbol	Density (g/ml)
15	P	1.82
16	S	2.07
17	Cl	0.00321
18	Ar	0.00184
19	K	0.086
20	Ca	1.55
21	Sc	2.99
22	Ti	4.54
23	V	6.11



(Axis Off)

## Part Two

Atomic Number	Element Symbol	Density (g/ml)
34	Sn	4.79

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