TOP TRUMPS ELEMENTS

Secondary Support Pack

INTRODUCTION

The periodic table of the elements is central to chemistry as we know it today and the study of it is a key part of every student's chemical education. By playing the Elements Top Trumps™ game, students will:

- **be introduced to some of the different elements within the periodic table;**
- **be encouraged to look at, and compare, the appearance and properties of the different elements;**
- **make connections between an element's appearance and its properties, eg elements which are gases have low densities and low melting points, those which are metals have higher melting points and higher densities;**
- **be introduced to how scientific discoveries build up over time through the inclusion of the discovery date for each element.**

This resource provides some activities that could be carried out using the Elements Top Trumps™ pack in addition to playing 'Top Trumps™'. The activities are aimed at students aged 11-14 and are designed to familiarise the students further with the elements, their symbols and properties whilst at the same time developing the students' understanding of patterns within the periodic table.

Throughout these activities the Royal Society of Chemistry's Periodic Table (http://www.rsc.org/periodic-table/) can be used either by the teacher or the students independently to enhance the learning.

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1 Chemical bingo

Curriculum link: Familiarisation with chemical names and symbols

By playing this simple game with the students, the students become familiar with the names and chemical symbols of some of the different elements in the periodic table. An extension would be for the teacher to describe the element instead of giving its name or symbol, hence encouraging the students to study the elements further and become familiar with their physical appearance, uses or properties.

2 Classification of elements

Curriculum link: The varying physical and chemical properties of different elements

Initially the students are asked to look through the 30 elements included in the pack and pick out the metals. By then identifying the position of these elements on the periodic table they will see that generally metals lie to the left and non-metals to the right. Hydrogen is identified as the obvious exception.

The students are then asked to look at certain metals and identify their uses and the specific properties they have that make them appropriate for this use.

3 Grouping elements

Curriculum link: Identifying patterns

In this activity the students are asked to gather the elements in group 1 and the elements in group 17, arrange the elements as they are found in the periodic table and identify similarities and differences between elements in the same group. By doing this, they will be introduced to the idea of atoms having size, become aware of element reactivity and begin to spot the patterns that are the crux of the periodic table.

4 Predicting properties

Curriculum link: Making predictions using scientific knowledge and understanding

This activity takes the 'Grouping elements' activity to the next level by asking the students to identify the similarities and trends within groups and then use these to predict properties of elements for which they are not provided with cards – in much the same way as Mendeleev did. The activity ends with the students being asked to reflect on which predictions might be more reliable than others and introduces evaluation skills. For example, can you reliably predict a property from a group in which you know the properties of only two other elements?

5 Discovery of the elements

Curriculum link: Presenting observations and data using appropriate methods; Understanding how scientific methods and theories develop

This activity encourages cross-curricular links between mathematics and science and between science and history. The students are initially asked to complete a tally chart for the year in which different elements were discovered and then show this data on a histogram. They are then asked to reflect on their findings and in doing so make links between the properties of the elements, where they might be found and the Industrial Revolution of the early 19th century.

A visual representation of the timescale of the discovery of the elements can be seen using the 'History' tab on the Periodic Table http://www.rsc.org/periodic-table/history.

6 Size and scale

Curriculum link: Applying mathematical concepts; Understanding and using SI units

In this final activity the students are asked to consider the size of the atom relative to objects whose size they are more familiar with. This activity requires them to apply their mathematical skills of measurements, converting units and calculating volumes. The scale of the numbers of atoms involved will prove a challenge to the students.

As an extension to this task the students could research how atoms are arranged in metals and evaluate how accurate they think their answers are.

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1 CHEMICAL BINGO

Curriculum link: Familiarisation with chemical names and symbols

Arrange 9 cards from your Elements Top Trumps™ pack in a three-by-three grid. An example is given below.

As the teacher reads out the name of an element, an element's chemical symbol, or describes the element to you, turn that card over. To win, you need to turn over a **'line'** of cards (either horizontal or vertical) or a **'full house'** (all your cards). Remember to shout BINGO loudly when you have a 'line' or 'full house.'

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2 CLASSIFICATION OF ELEMENTS

Curriculum link: The varying physical and chemical properties of different elements

1. Separate out the elements which are described as **metals**. You can assume all the other elements in your pack are **non-metals**. You will also identify one element which is described as a **semi-metal**.

2. On the periodic table below, highlight the **metals** in one colour and the **non-metals** in a different colour.

H 1																	He 2
Li 3	Be 4											B 5	C 6	N 7	O 8	F 9	Ne 10
Na 11	Mg 12											Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
Cs 55	Ba 56	La 57	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
Fr 87	Ra 88	Ac 89	Rf 104	Db 105	Sg 106	Bh 107	Hs 108	Mt 109	Ds 110	Rg 111	Cn 112	Nh 113	Fl 114	Mc 115	Lv 116	Ts 117	Og 118

Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71
Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103

a. i. What do you notice about the position of the **metals**?

ii. What do you notice about the position of the **non-metals**?

iii. Which element is the exception to this rule?

b. Silicon and boron are normally grouped together with arsenic as semi-metals. What do you think a **semi-metal** is?

3. Look now at the metals in more detail. For each of the metals listed below, describe what they are **used for** and what **properties** they have that make them good for this use.

Metal	Used for...	Properties that make it good for this use
Magnesium		
Aluminium		
Gold		
Copper		
Osmium		

If a metal is described as **lightweight**, what do you notice about its **density**?

3 GROUPING ELEMENTS

Curriculum link: Identifying patterns

Group = The elements in the same **column** in the periodic table

Period = The elements in the same **row** in the periodic table

1. Group together the elements in **group 1** and arrange the cards as they are found in the periodic table. Do not include hydrogen as it is not a typical group 1 element.

   a. Identify two **similarities** between the elements in this group.

   b. Identify two **trends in the properties** of the elements as you move down the group. For each property decide if it is a **chemical property** or a **physical property**.

Extension research: Find out why hydrogen is often placed in group 1 even though it does not fit the pattern.

2. Group together the elements in **group 17** of the periodic table (note: group 17[†] starts with the element fluorine). Arrange the cards as they are found in the periodic table.

   a. Identify two **similarities** between the elements in this group.

   b. Identify two **trends in the properties** of the elements as you move down the group.

3. Compare the trends you have identified for the **group 1** elements and the **group 17** elements. Identify one trend which is the same and one trend which is different.

   Trend which is **the same** in group 1 and group 17:

   Trend which is **different** in group 1 and group 17:

[†] *You may be more familiar with this group as group 7. However according to the IUPAC rules it is officially group 17. Which block of elements has been included to make it group 17?*

4 PREDICTING PROPERTIES

Curriculum link: Making predictions using scientific knowledge and understanding

When Mendeleev put together his periodic table of the elements in 1869, he left gaps for elements that had not yet been discovered. He was able to predict the properties of these elements by looking at the other elements in the same group and identifying similarities and trends in their chemical and physical properties.

Your job now is to repeat the work of Mendeleev and predict the properties of four elements you do not have cards for. For each of the 'yet to be discovered' elements with cards shown below:

1. Select the cards for the other elements in the same **group** as the element and arrange them as they are found in the periodic table, leaving a gap for the 'yet to be discovered' element.
2. Look at the other elements in the group and identify any similarities and trends in their chemical and physical properties.
3. Use these to complete the new Top Trumps cards below. You may not be able to make reliable predictions for all of the properties.

RUBIDIUM

Metal / non-metal
Solid / liquid / gas
Melting point:..... °C
Size of atom:..... pm
Chemical reactivity:
.....
.....
.....

IODINE

Metal / non-metal
Solid / liquid / gas
Melting point:..... °C
Size of atom:..... pm
Chemical reactivity:
.....
.....
.....

ARGON

Metal / non-metal
Solid / liquid / gas
Melting point:..... °C
Size of atom:..... pm
Chemical reactivity:
.....
.....
.....

Which predictions are **more reliable** than others? Why?

You can check your predictions by looking up the elements on the Periodic Table **www.rsc.org/periodic-table/**. To work out the size of the atom in picometres (pm) find the atomic radius in Angstroms (Å) and multiply by 200.

5 DISCOVERY OF THE ELEMENTS

Curriculum link: Presenting observations and data using appropriate methods; Understanding how scientific methods and theories develop

1. On each of the element cards, the year of discovery is given.

   Complete the tally chart for the 30 elements in your pack.

Year of discovery	Frequency
Before 1750	
1751 - 1800	
1801 - 1850	
1851 - 1900	
1901 - 1950	
1951 - 2000	
2001 to present day	

2. Represent this information as a histogram using the squared paper opposite;

3. In which time period were **most** elements discovered? Why do you think this was the case?

4. Look at the elements that were discovered BC. Why do you think these elements were some of the earliest to be known?

6 SIZE AND SCALE

Curriculum links: Applying mathematical concepts; Understanding and using SI units

The sizes of the atoms are given on the Elements cards as the diameter of the atom in units of picometres (pm) where one picometre is one trillionth of a metre
(1 pm = 1 ÷ 1,000,000,000,000 m). Therefore:

centimetre, cm ⟶ (**× 10,000,000,000**) ⟶ picometre, pm

centimetre, cm ⟵ (**÷ 10,000,000,000**) ⟵ picometre, pm

1. Modern 1p and 2p coins are made from steel covered with a layer of copper.

   a. What is the diameter of a 2p coin in:

      i. centimetres? _____ cm

      ii. picometres? _____ pm

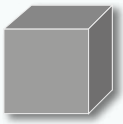
   b. Assuming the copper atoms that cover the steel coin are arranged in a straight line, and go from edge to edge with no gaps, how many copper atoms are there across the diameter of one face of the coin?

      The number of copper atoms across the diameter of the face of a 2p coin is _____

2. Sodium is a reactive metal that reacts with water.

   A common classroom demonstration is to drop a cube of sodium in water and observe the reaction.

   a. What is the length of one side of the cube of sodium shown in:



      i. centimetres? _____ cm

      ii. picometres? _____ pm

   b. Again, assume the sodium atoms line up along the edges of the cube in a straight line and go from edge to edge with no gaps. How many sodium atoms are there along each edge of the cube?

      _____

   c. Therefore how many sodium atoms **in total** do you think there are in a cube of sodium this size?

      _____

Extension research:
Find out how atoms are arranged in metals.
How accurate are your answers to Question 2 parts (b) and (c)?

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