

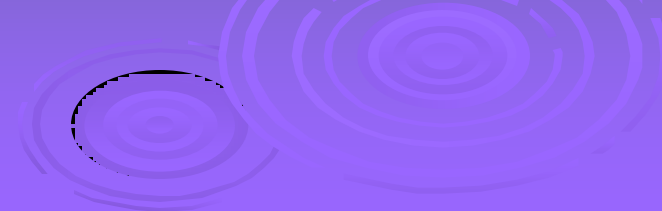
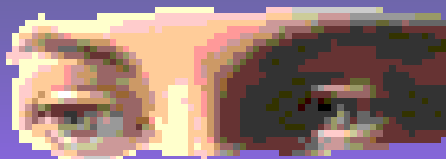
The image shows a periodic table of elements with orbitals highlighted in different colors: s (blue), p (green), d (pink), and f (orange). The orbitals are labeled as follows:

- s orbitals:** 1s, 2s, 3s, 4s, 5s, 6s, 7s
- p orbitals:** 2p, 3p, 4p, 5p, 6p, 7p
- d orbitals:** 3d, 4d, 5d, 6d
- f orbitals:** 4f, 5f

The periodic table is organized into groups (1-18) and periods (1-7). The elements are color-coded according to their orbital configuration.



CHAPTER 4: PERIODIC TABLE



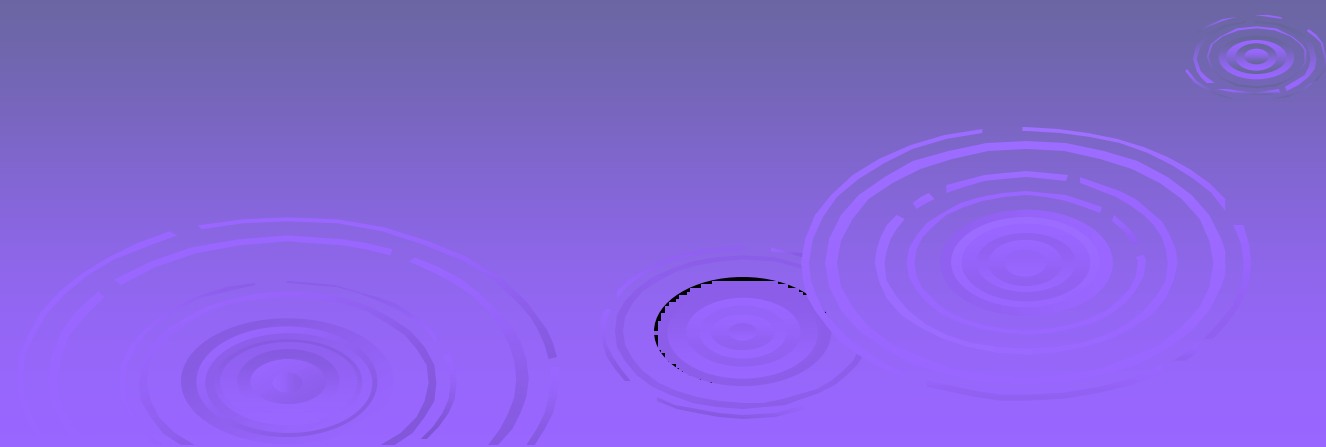
LECTURE 1

LEARNING OUTCOMES

- At the end of the lesson the students should be able to :
 - (a) Indicate period, group and block (*s*, *p*, *d*, *f*).
 - (b) Specify the position of metals, metalloids and non-metals in the periodic table.
 - (c) Deduce the position of elements in the periodic table from its electronic configuration.

4.1 Period, Group and Block(s,p,d,f)

- The periodic table is a table that arranges all the known elements in order of increasing **proton number**.
- A **vertical** column of elements is called a **group**.
- A **horizontal** row of elements is known as a **period**.





4.1.1 Groups

- The groups in the Periodic Table are numbered from **1 to 18**.
- Elements in the same group have the **same** number of **valence electrons**.
- Example: Sodium and potassium are both found in group 1 which means that they both have 1 valence electron

1
H 1
Li 3
Na 11
K 19
Rb 37
Cs 55
Fr 87

Group number = number of valence electron, if the element is in block s and d

OR

Group number = number of v.e. + 10, if the element is in block p

Periodic Table

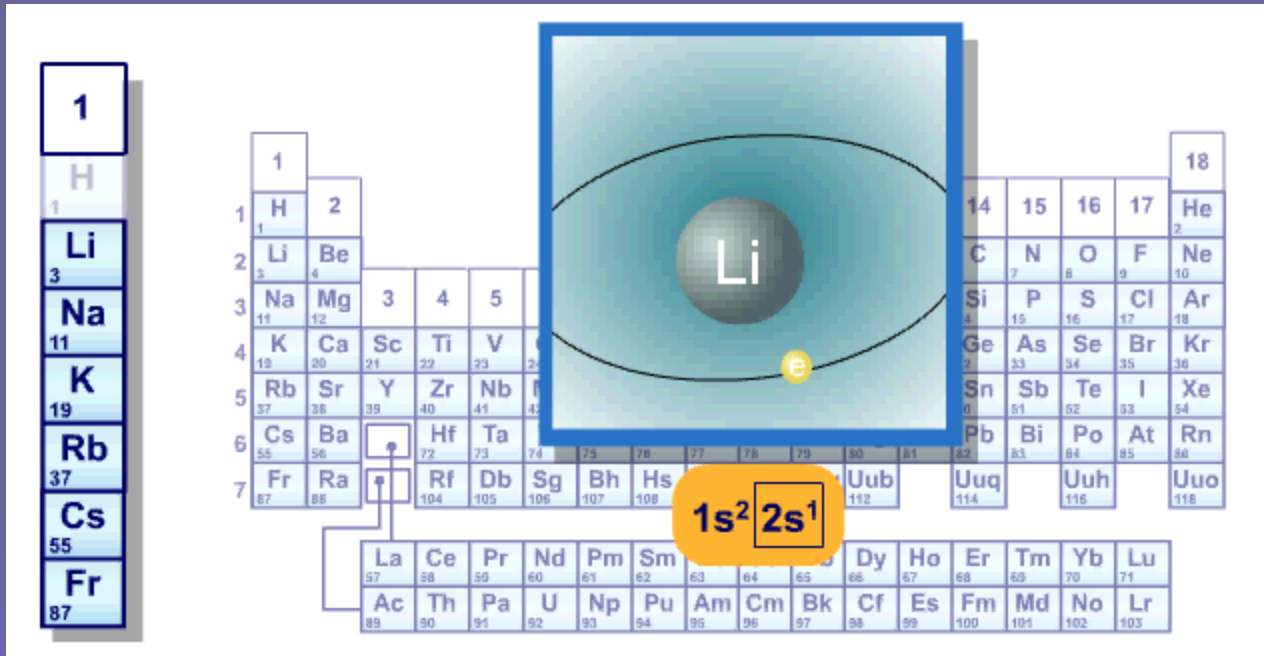
	1																18	
1	H 1	2										13	14	15	16	17	He 2	
2	Li 3	Be 4										5	6	7	8	9	10	
3	Na 11	Mg 12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
4	K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
5	Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
6	Cs 55	Ba 56		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
7	Fr 87	Ra 88		Rf 104	Db 105	Sg 106	Bh 107	Hs 108	Mt 109	Uun 110	Uuu 111	Uub 112		Uuq 114		Uuh 116		Uuo 118
				La 57	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
				Ac 89	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

Main group (Representative Group) in periodic table

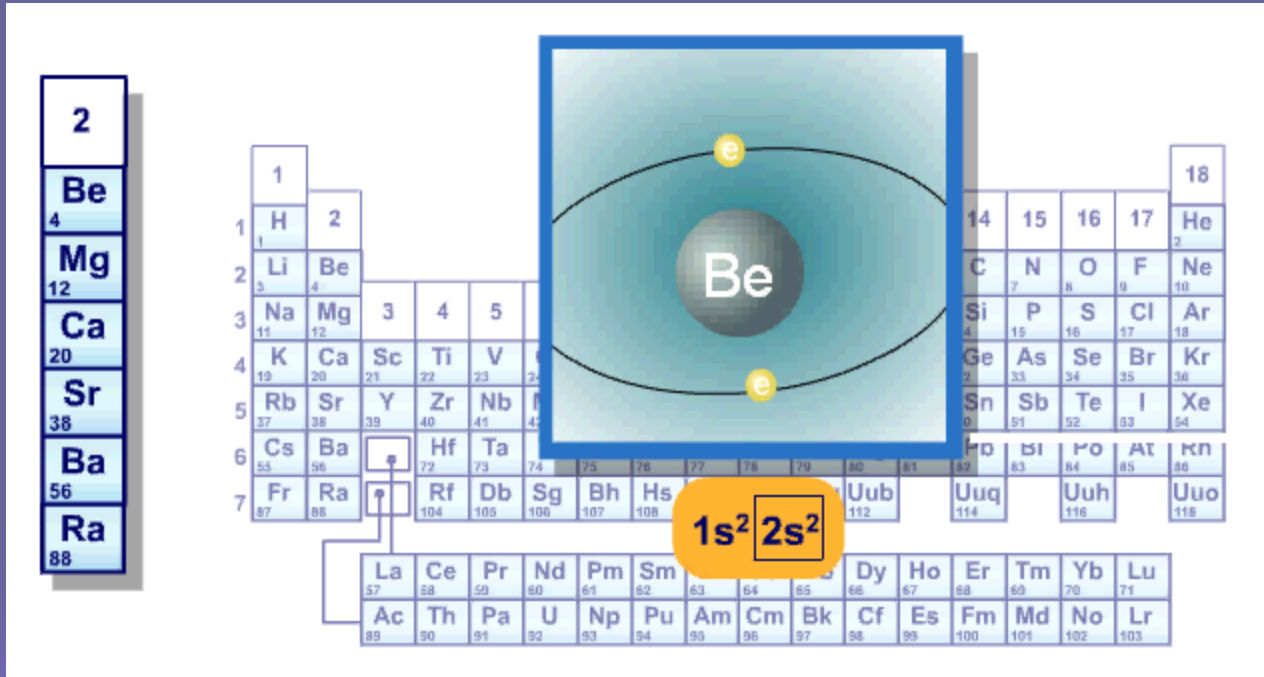
- Group 1 : alkali metals
- Group 2 : alkaline earth metals
- Group 3-12: transition metals
- Group 16 : chalcogens
- Group 17 : halogens
- Group 18 : inert / noble gases



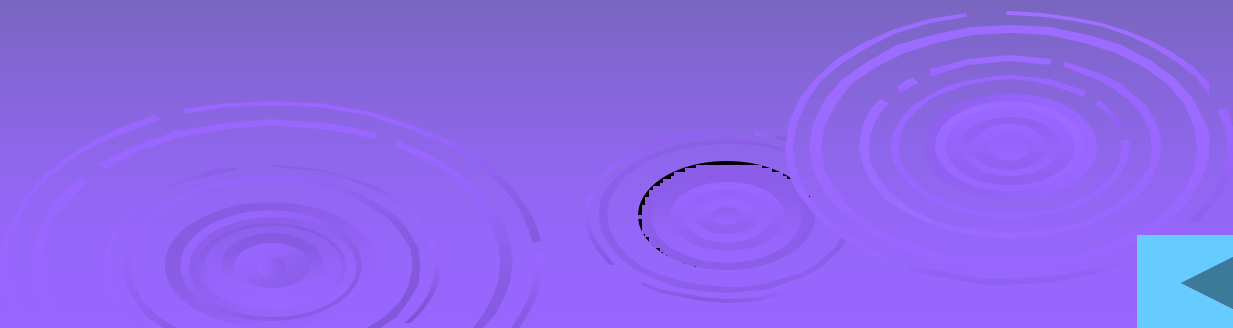
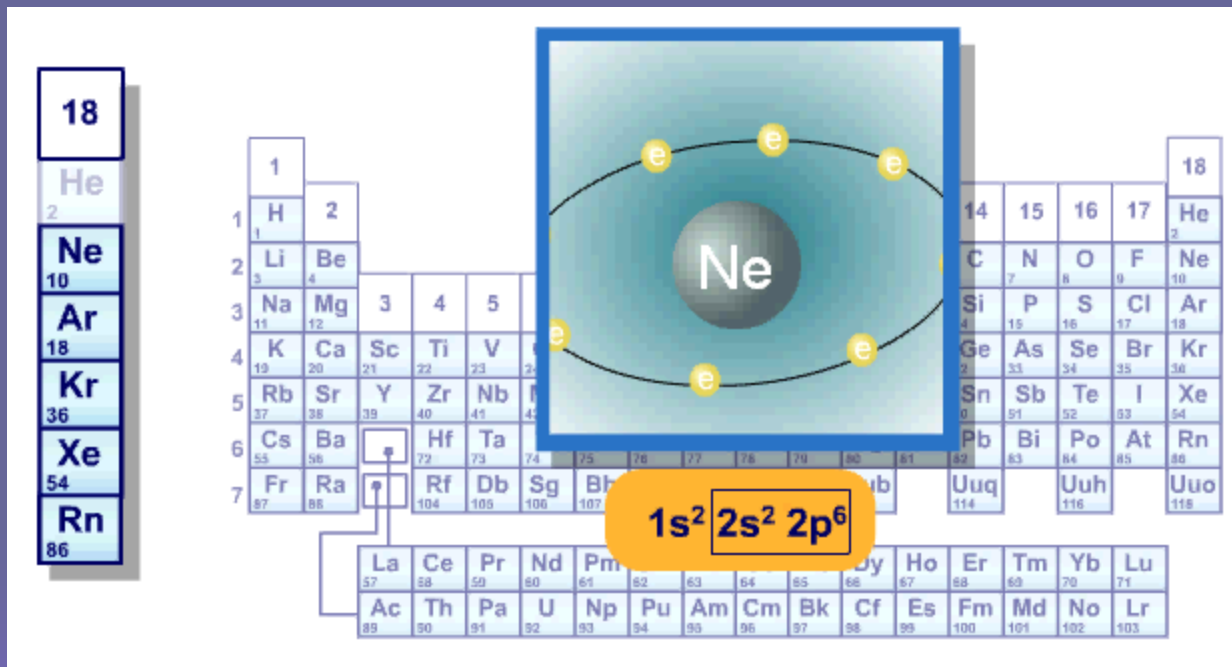
Alkali metal



Alkaline earth metal



Noble Gases





4.1.1 Period

Na 11	Mg 12	Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
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- The atoms of the elements in each period possess an identical number of **quantum levels**.
- Are numbered **1 to 7**.
- Example: Sodium and chlorine are in row 3 or Period 3 because their principal quantum number of the valence electron shell is 3.



Period number = principle quantum number, n , of the electrons in valence shell

4.1.1 Blocks

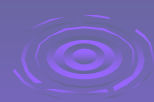
- All the elements in the periodic table can be classified into 4 main blocks according to their valence electron configuration.
- These main blocks are block *s*, *p*, *d* and *f*.

The image shows a periodic table with four main blocks highlighted in different colors and labeled with their respective letters: s (blue), p (green), d (pink), and f (orange). The s-block includes groups 1 and 2, the p-block includes groups 13-18, the d-block includes groups 3-10, and the f-block includes the lanthanide and actinide series. The table is color-coded: s-block is blue, p-block is green, d-block is pink, and f-block is orange. The labels 's', 'p', 'd', and 'f' are placed in large letters next to their respective blocks. The periodic table is divided into four main blocks: s, p, d, and f. The s-block is on the left, the p-block is on the right, the d-block is in the middle, and the f-block is at the bottom. The elements are arranged in rows and columns, with their atomic numbers and symbols visible. The s-block includes groups 1 and 2, the p-block includes groups 13-18, the d-block includes groups 3-10, and the f-block includes the lanthanide and actinide series.

1	2											13	14	15	16	17	18	
1s	2s											2p	3p	4p	5p	6p	7p	
Li	Be											B	C	N	O	F	Ne	
Na	Mg											Al	Si	P	S	Cl	Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub	Uuq	Uuh	Uuh	Uuh	Uuo		
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		

s Block :

- Groups 1 and 2
- Filling of valence electron only involve s orbital
- Configuration of valence electron : ns^1 to ns^2
- Example:



p Block :

- Groups 13 to 18
- Configuration of valence electrons:
 $ns^2 np^1$ to $ns^2 np^6$.
- Example:



d Block

- Also known as a transition elements.
- Groups 3 to 12.
- Configuration of valence electron:
 $(n-1)d^1 ns^2$ to $(n-1)d^{10} ns^2$
- Example:



f Block

- Involve elements in the series of **lanthanides** (Ce to Lu) and **actinides** (Th to Lr) in which the filling of valences electron happens in the subshell of **4f** and **5f**

La 57	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
Ac 89	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

Lanthanides

actinides

1																	18																																																												
1s	2											13	14	15	16	17	1s																																																												
Li	Be											B	C	N	O	F	Ne																																																												
Na	Mg	3	4	5	6	7	8	9	10	11	12	Al	Si	P	S	Cl	Ar																																																												
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																																																												
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																																																												
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																																																												
Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub		Uuq	Uuh			Uuo																																																												
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Periodic Table



4.1.2 Metal, nonmetal and metalloids

- All the elements on the left side and in the middle of the periodic table (except for hydrogen) are **metallic elements**, or **metals**.

metals

1																	18	
1	H																	He
2	Li	Be																Ne
3	Na	Mg																Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub		Uuq		Uuh		Uuo
				La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
				Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

- The metals are separated from the **non-metallic** elements by the diagonal step-like line that runs from boron (B) to Astatine (At) as shown:

nonmetals

1	2											13	14	15	16	17	18																																																											
1 H												B	C	N	O	F	He																																																											
2 Li	Be											Al	Si	P	S	Cl	Ar																																																											
3 Na	Mg	3	4	5	6	7	8	9	10	11	12	Ga	Ge	As	Se	Br	Kr																																																											
4 K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	In	Sn	Sb	Te	I	Xe																																																											
5 Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	Hg	Tl	Pb	Bi	Po	At																																																											
6 Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																																																											
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La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																																																														
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71																																																														
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr																																																														
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103																																																														

- Further across the period towards the right, elements gradually lose their metallic character and gained nonmetallic features.

- Many of the elements that lie along the line that separates metals from non-metals, such as antimony (Sb) have properties that fall between those of metals and non-metals.
- These elements are often referred to as **metalloids**.(semi-metals)

metalloids

1	1																	18
1	H																	He
2	Li	Be																Ne
3	Na	Mg																Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub		Uuq		Uuh		Uuo
				La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
				Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

➤

4.1.3 Position of elements from its electron configuration:

➤ E.g:

Classify the following elements into its appropriate group, period and block.

P : $1s^2 2s^2 2p^6 3s^2 3p^6$

Q: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

R : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

S : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$

T : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

Answer

Element	Group	Period	Class/block
P	18	3	Inert gas/block p
Q	17	4	Block p
R	2	4	Block s
S	5	4	Transition element/ block d
T	18	4	Inert gas/block p

End of lecture 1...

