APPENDIX A

For office use

INTEREST QUESTIONNAIRE FOR THE NATURAL SCIENCE FIELD OF STUDY (IQNSFS) – adapted from Swanepoel, C.H. (1986)

Respondent V1 [ ][ ][ ][ ] 1

What is your surname?

What are your initials?

What is your gender?

Male	**1**	V2 [ ]	5
Female	**2**		

For each item below, indicate to what extent you would like to practice the activity

Please use the code:

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	Item	N	D	S	V			
1	Make a model of the wiring of lights in a house	**0**	**1**	**2**	**3**	V3	[ ]	6
2	Determine the product of two algebraic fractions	**0**	**1**	**2**	**3**	V4	[ ]	7
3	Solve a problem by means of a computer in line with given nstructions	**0**	**1**	**2**	**3**	V5	[ ]	8
4	Watch a television programme on what happens to a light ray when it passes through Perspex	**0**	**1**	**2**	**3**	V6	[ ]	9
5	Determine the amount of work done in lifting up an object	**0**	**1**	**2**	**3**	V7	[ ]	10
6	Study the anatomy of a grasshopper	**0**	**1**	**2**	**3**	V8	[ ]	11
7	Find out if it is better to buy 24 small containers of cool drink than 6 large ones	**0**	**1**	**2**	**3**	V9	[ ]	12
8	Watch a television programme on the kinds of memories used in computers	**0**	**1**	**2**	**3**	V1	[ ]	13
9	Play mathematical games	**0**	**1**	**2**	**3**	V1	[ ]	14
10	Cultivate indigenous plants	**0**	**1**	**2**	**3**	V1	[ ]	15
11	Conduct an experiment to test for starch in a green Leaf	**0**	**1**	**2**	**3**	V1	[ ]	16

For each item below, indicate to what extent you would like to practice the activity

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	Item	N	D	S	V			
12	Solve a geometry problem	**0**	**1**	**2**	**3**	V14		17
13	Demonstrate to others what a computer can do	**0**	**1**	**2**	**3**	V15		18
14	Find out how a hydraulic jack helps one to easily lift up a heavy car	**0**	**1**	**2**	**3**	V16		19
15	Establish by means of an experiment that carbon dioxide is given off during respiration in germinating seeds	**0**	**1**	**2**	**3**	V17		20
16	Find out the meaning of computer terms such as operating system, memory and software	**0**	**1**	**2**	**3**	V18		21
17	Study micro-organisms under a microscope	**0**	**1**	**2**	**3**	V19		22
18	Prove a given theorem	**0**	**1**	**2**	**3**	V20		23
19	Read about how a hydrogen bomb is made	**0**	**1**	**2**	**3**	V21		24
20	Find a suitable method of separating a mixture of salt and sand	**0**	**1**	**2**	**3**	V22		25
21	Listen to a presentation on how computers use Memory	**0**	**1**	**2**	**3**	V23		26
22	Try to cultivate a new species of potato	**0**	**1**	**2**	**3**	V24		27
23	Combine two elements to form a compound in a chemical process	**0**	**1**	**2**	**3**	V25		28
24	Study different computer programs	**0**	**1**	**2**	**3**	V26		29
25	Derive a formula in mathematics	**0**	**1**	**2**	**3**	V27		30
26	Study the life cycle of a parasite	**0**	**1**	**2**	**3**	V28		31
27	Learn to use a computer program	**0**	**1**	**2**	**3**	V29		32
28	Answer questions from a graph in mathematics	**0**	**1**	**2**	**3**	V30		33
29	Establish by means of an experiment the reaction of various metals with an acid	**0**	**1**	**2**	**3**	V31		34
30	Modify a computer program	**0**	**1**	**2**	**3**	V32		35
31	Divide learners into groups according to their Performance in a test	**0**	**1**	**2**	**3**	V33		36
32	Take part in a conversation about pressure changes when the depth or density of a liquid changes	**0**	**1**	**2**	**3**	V34		37
33	Watch a television program on the importance of water in nutrition	**0**	**1**	**2**	**3**	V35		38
34	Determine the height of a tall building	**0**	**1**	**2**	**3**	V36		39
35	Extract gold from gold ore	**0**	**1**	**2**	**3**	V37		40
36	Represent in a diagram the way a computer executes instructions	**0**	**1**	**2**	**3**	V38		41
37	Measure voltage in parallel and series circuits	**0**	**1**	**2**	**3**	V39		42

For each item below, indicate to what extent you would like to practice the activity

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	Item	N	D	S	V			
38	Study how a bird's digestive system works	**0**	**1**	**2**	**3**	V40		43
39	Listen to a presentation on the fields in which a computer can be used	**0**	**1**	**2**	**3**	V41		44
40	Design a computer program to establish how many entries are required to win in the different levels of a lottery	**0**	**1**	**2**	**3**	V42		45
41	Read about the role of a liver in nutrition	**0**	**1**	**2**	**3**	V43		46
42	Take measurements of a house to determine if certain furniture can fit in	**0**	**1**	**2**	**3**	V44		47
43	Read an article on how to measure sound	**0**	**1**	**2**	**3**	V45		48
44	Demonstrate by means of an experiment the action of saliva on starch	**0**	**1**	**2**	**3**	V46		49
45	Conduct research on what nutrients will enable a fruit tree to bear the most fruit	**0**	**1**	**2**	**3**	V47		50
46	Write the instructions for a computer to solve a business problem	**0**	**1**	**2**	**3**	V48		51
47	Calculate what R500 will be worth in 25 years' time	**0**	**1**	**2**	**3**	V49		52
48	Study the operation of a camera	**0**	**1**	**2**	**3**	V50		53
49	Explain how a computer adds up two numbers	**0**	**1**	**2**	**3**	V51		54
50	Provide proof from a number of mathematical Data	**0**	**1**	**2**	**3**	V52		55
51	Calculate how many bricks are required to build a house	**0**	**1**	**2**	**3**	V53		56
52	Study theories on the cause of lightning	**0**	**1**	**2**	**3**	V54		57
53	Conduct experiments to determine the ideal temperature and humidity for a certain plant to blossom	**0**	**1**	**2**	**3**	V55		58
54	Explain to someone, step by step, how to write a letter using a computer.	**0**	**1**	**2**	**3**	V56		59
55	Study the characteristics of a newly discovered plant	**0**	**1**	**2**	**3**	V57		60
56	Determine by means of certain formulas how large the population of the country will be in 20 years' time.	**0**	**1**	**2**	**3**	V58		61
57	Verify the data in a computer printout	**0**	**1**	**2**	**3**	V59		62
58	Watch a TV program on the use of mathematics in everyday life	**0**	**1**	**2**	**3**	V60		63

For each item below, indicate to what extent you would like to practice the activity

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	Item	N	D	S	V			
59	Study the effect of resistance in a circuit	**0**	**1**	**2**	**3**	V61		64
60	Use a formula using a computer	**0**	**1**	**2**	**3**	V62		65
61	Calculate the area of a floor to determine how many tiles are needed	**0**	**1**	**2**	**3**	V63		66
62	Help to prune trees in a nursery	**0**	**1**	**2**	**3**	V64		67
63	Do research on petrol from coal	**0**	**1**	**2**	**3**	V65		68
64	Establish with the aid of a computer the popularity of some politicians	**0**	**1**	**2**	**3**	V66		69
65	Watch a television program on the difference between a mainframe, mini- and microcomputers	**0**	**1**	**2**	**3**	V67		70
66	Calculate what it costs to build a school	**0**	**1**	**2**	**3**	V68		71
67	Dissect a rat to find out how its digestive system works	**0**	**1**	**2**	**3**	V69		72
68	Undergo training on computer programming	**0**	**1**	**2**	**3**	V70		73
69	Read an article on the effect of the moon on the Earth	**0**	**1**	**2**	**3**	V71		74
70	Investigate why windmills are often used as power pumps in South Africa	**0**	**1**	**2**	**3**	V72		75
71	Study the graph that shows the level of the blood sugar of a diabetic during a 12 hour period	**0**	**1**	**2**	**3**	V73		76
72	Set a question paper on mathematics	**0**	**1**	**2**	**3**	V74		77
73	Play games on a computer	**0**	**1**	**2**	**3**	V75		78
74	Put together the skulls of different animals for an exhibition	**0**	**1**	**2**	**3**	V76		79
75	Discuss how mathematics can be used in other Subjects	**0**	**1**	**2**	**3**	V77		80
76	Watch a television programme on how the behaviour of owls is observed	**0**	**1**	**2**	**3**	V78		81
77	Explain to someone how to use a voltmeter	**0**	**1**	**2**	**3**	V79		82
78	Correctly solve a problem using a method that your teacher did not teach you about	**0**	**1**	**2**	**3**	V80		83
79	Use the computer to teach a foreign language, such as German	**0**	**1**	**2**	**3**	V81		84
80	Determine the maximum force that can be exerted by a person's leg muscle	**0**	**1**	**2**	**3**	V82		85
81	Build a model to represent a water molecule					V83		86

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	Item	N	D	S	V			
82	Do calculations with fractions	**0**	**1**	**2**	**3**	V84		87
83	Mark sea-birds to collect information on their migration and breeding habits	**0**	**1**	**2**	**3**	V85		88
84	Burn some elements in oxygen	**0**	**1**	**2**	**3**	V86		89

Thank you for your time, co-operation and participation in this Questionnaire

APPENDIX B

The FREQ Procedure

V2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	183	43.88	183	43.88
2	234	56.12	417	100.00

V3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	72	17.27	72	17.27
1	176	42.21	248	59.47
2	110	26.38	358	85.85
3	59	14.15	417	100.00

V4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	66	15.83	66	15.83
1	140	33.57	206	49.40
2	163	39.09	369	88.49
3	48	11.51	417	100.00

V5	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	11	2.64	11	2.64
1	58	13.91	69	16.55
2	110	26.38	179	42.93
3	238	57.07	417	100.00

V6	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	37	8.87	37	8.87
1	109	26.14	146	35.01
2	168	40.29	314	75.30
3	103	24.70	417	100.00

V7	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	48	11.51	48	11.51
1	126	30.22	174	41.73
2	132	31.65	306	73.38
3	111	26.62	417	100.00

The FREQ Procedure

V8	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	77	18.47	77	18.47
1	131	31.41	208	49.88
2	120	28.78	328	78.66
3	89	21.34	417	100.00

V9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	42	10.07	42	10.07
1	100	23.98	142	34.05
2	133	31.89	275	65.95
3	142	34.05	417	100.00

V10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	12	2.88	12	2.88
1	50	11.99	62	14.87
2	88	21.10	150	35.97
3	267	64.03	417	100.00

V11	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	27	6.49	27	6.49
1	56	13.46	83	19.95
2	83	19.95	166	39.90
3	250	60.10	416	100.00

Frequency Missing = 1

V12	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	32	7.67	32	7.67
1	150	35.97	182	43.65
2	152	36.45	334	80.10
3	83	19.90	417	100.00

V13	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	62	14.87	62	14.87
1	140	33.57	202	48.44
2	134	32.13	336	80.58
3	81	19.42	417	100.00

The FREQ Procedure

V14	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	56	13.43	56	13.43
1	117	28.06	173	41.49
2	133	31.89	306	73.38
3	111	26.62	417	100.00

V15	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	13	3.12	13	3.12
1	48	11.51	61	14.63
2	121	29.02	182	43.65
3	235	56.35	417	100.00

V16	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	58	13.91	58	13.91
1	110	26.38	168	40.29
2	130	31.18	298	71.46
3	119	28.54	417	100.00

V17	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	55	13.19	55	13.19
1	127	30.46	182	43.65
2	132	31.65	314	75.30
3	103	24.70	417	100.00

V18	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	6	1.44	6	1.44
1	48	11.51	54	12.95
2	88	21.10	142	34.05
3	275	65.95	417	100.00

V19	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	27	6.47	27	6.47
1	70	16.79	97	23.26
2	110	26.38	207	49.64
3	210	50.36	417	100.00

The FREQ Procedure

V20	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	62	14.87	62	14.87
1	160	38.37	222	53.24
2	143	34.29	365	87.53
3	52	12.47	417	100.00

V21	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	29	6.95	29	6.95
1	92	22.06	121	29.02
2	93	22.30	214	51.32
3	203	48.68	417	100.00

V22	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	44	10.55	44	10.55
1	99	23.74	143	34.29
2	132	31.65	275	65.95
3	142	34.05	417	100.00

V23	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	8	1.92	8	1.92
1	28	6.71	36	8.63
2	83	19.90	119	28.54
3	298	71.46	417	100.00

V24	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	54	12.95	54	12.95
1	128	30.70	182	43.65
2	169	40.53	351	84.17
3	66	15.83	417	100.00

V25	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	48	11.51	48	11.51
1	133	31.89	181	43.41
2	120	28.78	301	72.18
3	116	27.82	417	100.00

The FREQ Procedure

V26	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	10	2.40	10	2.40
1	26	6.24	36	8.63
2	48	11.51	84	20.14
3	333	79.86	417	100.00

V27	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	35	8.39	35	8.39
1	118	28.30	153	36.69
2	121	29.02	274	65.71
3	143	34.29	417	100.00

V28	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	31	7.43	31	7.43
1	119	28.54	150	35.97
2	151	36.21	301	72.18
3	116	27.82	417	100.00

V29	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	7	1.68	7	1.68
1	29	6.95	36	8.63
2	53	12.71	89	21.34
3	328	78.66	417	100.00

V30	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	38	9.11	38	9.11
1	96	23.02	134	32.13
2	119	28.54	253	60.67
3	164	39.33	417	100.00

V31	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	86	20.62	86	20.62
1	133	31.89	219	52.52
2	144	34.53	363	87.05
3	54	12.95	417	100.00

The FREQ Procedure

V32	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	18	4.32	18	4.32
1	56	13.43	74	17.75
2	129	30.94	203	48.68
3	214	51.32	417	100.00

V33	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	63	15.11	63	15.11
1	70	16.79	133	31.89
2	107	25.66	240	57.55
3	177	42.45	417	100.00

V34	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	57	13.70	57	13.70
1	133	31.97	190	45.67
2	151	36.30	341	81.97
3	75	18.03	416	100.00

Frequency Missing = 1

V35	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	22	5.28	22	5.28
1	62	14.87	84	20.14
2	115	27.58	199	47.72
3	218	52.28	417	100.00

V36	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	49	11.75	49	11.75
1	110	26.38	159	38.13
2	159	38.13	318	76.26
3	99	23.74	417	100.00

V37	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	46	11.03	46	11.03
1	112	26.86	158	37.89
2	137	32.85	295	70.74
3	122	29.26	417	100.00

The FREQ Procedure

V38	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	21	5.04	21	5.04
1	78	18.71	99	23.74
2	114	27.34	213	51.08
3	204	48.92	417	100.00

V39	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	65	15.59	65	15.59
1	125	29.98	190	45.56
2	129	30.94	319	76.50
3	98	23.50	417	100.00

V40	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	38	9.11	38	9.11
1	113	27.10	151	36.21
2	122	29.26	273	65.47
3	144	34.53	417	100.00

V41	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	12	2.88	12	2.88
1	58	13.91	70	16.79
2	104	24.94	174	41.73
3	243	58.27	417	100.00

V42	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	21	5.04	21	5.04
1	66	15.83	87	20.86
2	116	27.82	203	48.68
3	214	51.32	417	100.00

V43	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	29	6.95	29	6.95
1	113	27.10	142	34.05
2	167	40.05	309	74.10
3	108	25.90	417	100.00

The FREQ Procedure

V44	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	47	11.27	47	11.27
1	133	31.89	180	43.17
2	122	29.26	302	72.42
3	115	27.58	417	100.00

V45	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	35	8.39	35	8.39
1	96	23.02	131	31.41
2	128	30.70	259	62.11
3	158	37.89	417	100.00

V46	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	70	16.79	70	16.79
1	162	38.85	232	55.64
2	133	31.89	365	87.53
3	52	12.47	417	100.00

V47	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	30	7.19	30	7.19
1	104	24.94	134	32.13
2	147	35.25	281	67.39
3	136	32.61	417	100.00

V48	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	25	6.00	25	6.00
1	52	12.47	77	18.47
2	115	27.58	192	46.04
3	225	53.96	417	100.00

V49	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	34	8.15	34	8.15
1	88	21.10	122	29.26
2	115	27.58	237	56.83
3	180	43.17	417	100.00

The FREQ Procedure

V50	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	40	9.59	40	9.59
1	89	21.34	129	30.94
2	128	30.70	257	61.63
3	160	38.37	417	100.00

V51	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	25	6.00	25	6.00
1	71	17.03	96	23.02
2	122	29.26	218	52.28
3	199	47.72	417	100.00

V52	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	55	13.22	55	13.22
1	114	27.40	169	40.62
2	128	30.77	297	71.39
3	119	28.61	416	100.00

Frequency Missing = 1

V53	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	80	19.18	80	19.18
1	94	22.54	174	41.73
2	130	31.18	304	72.90
3	113	27.10	417	100.00

V54	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	60	14.39	60	14.39
1	133	31.89	193	46.28
2	130	31.18	323	77.46
3	94	22.54	417	100.00

V55	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	78	18.71	78	18.71
1	144	34.53	222	53.24
2	143	34.29	365	87.53
3	52	12.47	417	100.00

The FREQ Procedure

V56	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	17	4.08	17	4.08
1	46	11.03	63	15.11
2	86	20.62	149	35.73
3	268	64.27	417	100.00

V57	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	47	11.27	47	11.27
1	125	29.98	172	41.25
2	158	37.89	330	79.14
3	87	20.86	417	100.00

V58	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	39	9.35	39	9.35
1	110	26.38	149	35.73
2	149	35.73	298	71.46
3	119	28.54	417	100.00

V59	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	23	5.52	23	5.52
1	88	21.10	111	26.62
2	146	35.01	257	61.63
3	160	38.37	417	100.00

V60	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	49	11.75	49	11.75
1	82	19.66	131	31.41
2	98	23.50	229	54.92
3	188	45.08	417	100.00

V61	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	61	14.63	61	14.63
1	153	36.69	214	51.32
2	128	30.70	342	82.01
3	75	17.99	417	100.00

The FREQ Procedure

V62	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	18	4.32	18	4.32
1	53	12.71	71	17.03
2	95	22.78	166	39.81
3	251	60.19	417	100.00

V63	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	50	11.99	50	11.99
1	124	29.74	174	41.73
2	119	28.54	293	70.26
3	124	29.74	417	100.00

V64	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	76	18.23	76	18.23
1	139	33.33	215	51.56
2	143	34.29	358	85.85
3	59	14.15	417	100.00

V65	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	54	12.95	54	12.95
1	125	29.98	179	42.93
2	134	32.13	313	75.06
3	104	24.94	417	100.00

V66	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	51	12.23	51	12.23
1	123	29.50	174	41.73
2	118	28.30	292	70.02
3	125	29.98	417	100.00

V67	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	36	8.63	36	8.63
1	87	20.86	123	29.50
2	131	31.41	254	60.91
3	163	39.09	417	100.00

The FREQ Procedure

V68	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	47	11.27	47	11.27
1	93	22.30	140	33.57
2	130	31.18	270	64.75
3	147	35.25	417	100.00

V69	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	72	17.27	72	17.27
1	129	30.94	201	48.20
2	144	34.53	345	82.73
3	72	17.27	417	100.00

V70	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	21	5.04	21	5.04
1	52	12.47	73	17.51
2	93	22.30	166	39.81
3	251	60.19	417	100.00

V71	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	24	5.76	24	5.76
1	95	22.78	119	28.54
2	129	30.94	248	59.47
3	169	40.53	417	100.00

V72	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	29	6.95	29	6.95
1	86	20.62	115	27.58
2	155	37.17	270	64.75
3	147	35.25	417	100.00

V73	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	42	10.07	42	10.07
1	96	23.02	138	33.09
2	146	35.01	284	68.11
3	133	31.89	417	100.00

The FREQ Procedure

V74	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	68	16.31	68	16.31
1	102	24.46	170	40.77
2	102	24.46	272	65.23
3	145	34.77	417	100.00

V75	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	9	2.16	9	2.16
1	33	7.91	42	10.07
2	49	11.75	91	21.82
3	326	78.18	417	100.00

V76	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	48	11.51	48	11.51
1	145	34.77	193	46.28
2	152	36.45	345	82.73
3	72	17.27	417	100.00

V77	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	50	11.99	50	11.99
1	89	21.34	139	33.33
2	123	29.50	262	62.83
3	155	37.17	417	100.00

V78	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	68	16.31	68	16.31
1	105	25.18	173	41.49
2	142	34.05	315	75.54
3	102	24.46	417	100.00

V79	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	72	17.27	72	17.27
1	136	32.61	208	49.88
2	133	31.89	341	81.77
3	76	18.23	417	100.00

The FREQ Procedure

V80	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	59	14.15	59	14.15
1	122	29.26	181	43.41
2	118	28.30	299	71.70
3	118	28.30	417	100.00

V81	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	30	7.19	30	7.19
1	62	14.87	92	22.06
2	109	26.14	201	48.20
3	216	51.80	417	100.00

V82	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	49	11.75	49	11.75
1	156	37.41	205	49.16
2	146	35.01	351	84.17
3	66	15.83	417	100.00

V83	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	61	14.63	61	14.63
1	115	27.58	176	42.21
2	143	34.29	319	76.50
3	98	23.50	417	100.00

V84	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	60	14.39	60	14.39
1	107	25.66	167	40.05
2	124	29.74	291	69.78
3	126	30.22	417	100.00

V85	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	56	13.43	56	13.43
1	141	33.81	197	47.24
2	153	36.69	350	83.93
3	67	16.07	417	100.00

The FREQ Procedure

V86	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	63	15.11	63	15.11
1	114	27.34	177	42.45
2	118	28.30	295	70.74
3	122	29.26	417	100.00

APPENDIX C

For office use

NATURE OF SCIENTIFIC KNOWLEDGE SCALE QUESTIONNAIRE (NSKS) –(Rubba & Andersen , 1978

Respondent V1 [ ][ ] 1

What is your surname?

What are your initials?

What is your gender?

Male	**1**	V2 [ ] 3
Female	**2**	

For each item below, indicate to what extent you agree or disagree

Please use the code:

SA = *Strongly agree*
A = *Agree*
N = *Neutral*
D = *Disagree*
SD = *Strongly disagree*

	Item	RESPONSE						
1	Scientific laws, theories and concepts do not Express creativity	**SA**	**A**	**N**	**D**	**SD**	V3 [ ] 4	
2	Scientific knowledge is stated as simply as possible	**SA**	**A**	**N**	**D**	**SD**	V4 [ ] 5	
3	The laws, theories and concepts of biology, chemistry and physics are related	**SA**	**A**	**N**	**D**	**SD**	V5 [ ] 6	
4	The applications of scientific knowledge can be judged good or bad; but the knowledge itself cannot.	**SA**	**A**	**N**	**D**	**SD**	V6 [ ] 7	
5	It is incorrect to judge a piece of scientific knowledge as being good or bad	**SA**	**A**	**N**	**D**	**SD**	V7 [ ] 8	
6	If two scientific theories explain a scientist's chosen. observations equally well, the simpler theory is chosen	**SA**	**A**	**N**	**D**	**SD**	V8 [ ] 9	
7	Certain pieces of scientific knowledge are good and others are bad	**SA**	**A**	**N**	**D**	**SD**	V9 [ ] 10	
8	Even if the applications of a scientific theory are judged to be good, we should not judge the theory itself.	**SA**	**A**	**N**	**D**	**SD**	V10 [ ] 11	
9	Scientific knowledge need not be capable of experimental test.	**SA**	**A**	**N**	**D**	**SD**	V11 [ ] 12	
10	The laws, theories and concepts of biology, chemistry and physics are not linked.	SA	A	N	D	SD	V12 [ ] 13	
11	Consistency among test results is not a requirement for the acceptance of scientific knowledge.	**SA**	**A**	**N**	**D**	**SD**	V13 [ ] 14	

For each item below, indicate to what extent you agree or disagree

Please use the code:

SA = *Strongly agree*
A = *Agree*
N = *Neutral*
D = *Disagree*
SD = *Strongly disagree*

	Item	RESPONSE						
12	A piece of scientific knowledge will be accepted if the evidence can be obtained by other investigators working under similar conditions.	**SA**	**A**	**N**	**D**	**SD**	V14	15
13	The evidence for scientific knowledge need not be open to public examination	**SA**	**A**	**N**	**D**	**SD**	V15	16
14	Scientific laws, theories and concepts are not stated as simply as possible.	**SA**	**A**	**N**	**D**	**SD**	V16	17
15	There is an effort in science to build as great a number of laws, theories and concepts as possible.	**SA**	**A**	**N**	**D**	**SD**	V17	18
16	We accept scientific knowledge even though it may contain error.	**SA**	**A**	**N**	**D**	**SD**	V18	19
17	Scientific knowledge expresses the creativity of Scientists	**SA**	**A**	**N**	**D**	**SD**	V19	20
18	Moral judgement can be passed on scientific Knowledge	**SA**	**A**	**N**	**D**	**SD**	V20	21
19	The laws, theories and concepts of biology, chemistry and physics are not related	**SA**	**A**	**N**	**D**	**SD**	V21	22
20	Scientific laws, theories and concepts express creativity.	**SA**	**A**	**N**	**D**	**SD**	V22	23
21	It is meaningful to pass moral judgement on both the applications of scientific knowledge and the knowledge itself.	**SA**	**A**	**N**	**D**	**SD**	V23	24
22	The evidence for scientific knowledge must be Repeatable	**SA**	**A**	**N**	**D**	**SD**	V24	25
23	Scientific knowledge is not a product of human imagination.	**SA**	**A**	**N**	**D**	**SD**	V25	26
24	Relationships amongst the laws, theories and concepts of science do not contribute to the explanatory and predictive power of science.	**SA**	**A**	**N**	**D**	**SD**	V26	27
25	The truth of scientific knowledge is beyond doubt.	**SA**	**A**	**N**	**D**	**SD**	V27	28
26	Today's scientific laws, theories and concepts may have to be changed in the face of new evidence.	**SA**	**A**	**N**	**D**	**SD**	V28	29
27	We do not accept a piece of scientific knowledge unless it is free of error	**SA**	**A**	**N**	**D**	**SD**	V29	30
28	A scientific theory is similar to work of art in that both express creativity	**SA**	**A**	**N**	**D**	**SD**	V30	31
29	There is an effort in science to keep the number of laws, theories and concepts to a minimum.	**SA**	**A**	**N**	**D**	**SD**	V31	32

For each item below, indicate to what extent you agree or disagree

Please use the code:

SA = *Strongly agree*
A = *Agree*
N = *Neutral*
D = *Disagree*
SD = *Strongly disagree*

	Item	RESPONSE						
30	The various sciences contribute to a single organised body of knowledge.	**SA**	**A**	**N**	**D**	**SD**	V32	33
31	Scientific beliefs do not change over time	**SA**	**A**	**N**	**D**	**SD**	V33	34
32	Scientific knowledge is a product of human Imagination	**SA**	**A**	**N**	**D**	**SD**	V34	35
33	The evidence for a piece of scientific knowledge does not have to be repeatable.	**SA**	**A**	**N**	**D**	**SD**	V35	36
34	Scientific knowledge does not express the creativity of scientists.	**SA**	**A**	**N**	**D**	**SD**	V36	37
35	Biology, chemistry and physics are similar kinds of knowledge.	**SA**	**A**	**N**	**D**	**SD**	V37	38
36	If the applications of a piece of scientific knowledge are generally considered bad, then the piece of scientific knowledge is also considered to be bad.	**SA**	**A**	**N**	**D**	**SD**	V38	39
37	Scientific knowledge is subject to review and change.	**SA**	**A**	**N**	**D**	**SD**	V39	40
38	Scientific laws, theories and concepts are tested against reliable observations.	**SA**	**A**	**N**	**D**	**SD**	V40	41
39	If two scientific theories explain a scientist's observations equally well, the more complex theory is chosen.	**SA**	**A**	**N**	**D**	**SD**	V41	42
40	Scientific knowledge is specific as opposed to comprehensive	**SA**	**A**	**N**	**D**	**SD**	V42	43
41	Scientific theories are discovered, not created by man.	**SA**	**A**	**N**	**D**	**SD**	V43	44
42	Those scientific beliefs that were accepted in the past and have since been discarded should be judged in their historical context.	**SA**	**A**	**N**	**D**	**SD**	V44	45
43	Scientific knowledge is unchanging.	**SA**	**A**	**N**	**D**	**SD**	V45	46
44	Biology, chemistry and physics are different kinds of knowledge.	**SA**	**A**	**N**	**D**	**SD**	V46	47
45	Consistency amongst test results is a requirement for the acceptance of scientific knowledge.	**SA**	**A**	**N**	**D**	**SD**	V47	48
46	Scientific knowledge is comprehensive as opposed to specific.	**SA**	**A**	**N**	**D**	**SD**	V48	49
47	The laws, theories and concepts of biology, chemistry and physics are interwoven.	**SA**	**A**	**N**	**D**	**SD**	V49	50
48	A piece of scientific knowledge should not be judged good or bad.	**SA**	**A**	**N**	**D**	**SD**	V50	51

APPENDIX D

DIAGNOSTIC TEST (adapted from Novick & Menis, 1976).

SURNAME:_____ DATE_____

FIRST NAME:_____ AGE:_____

SEX: (MALE/FEMALE)_____

GRADE 11 DURATION: 30 Min

_____

NOTE: 1. Pocket calculators may be used.
2. This test does not contribute to your overall year-mark.

INSTRUCTIONS:

1. Relax and answer ALL questions.

2. All the questions must be answered in this ANSWER BOOK.

3. Rough work must be indicated as such and may be done on the last few blank pages AT THE END OF THE ANSWER BOOK.

4. A Periodic Table is given.

5. Explain or show how you arrived at your answer in the space provided. Also indicate your level of confidence (i.e. how sure you are that your answer is correct) in the space provided. Example:

Indicate your level of confidence (how sure are you that you are correct?)

0%	50%	100%

6. Determine your level of confidence as follows:

6.1 If you simply do not know how to solve the problem or you find it too difficult to solve, indicate your level of confidence as 0%

6.2 If you think that you fully understand the question and that your method of solving the problem is reasonable but still not sure if you have the right answer, indicate your level of confidence as 50%.

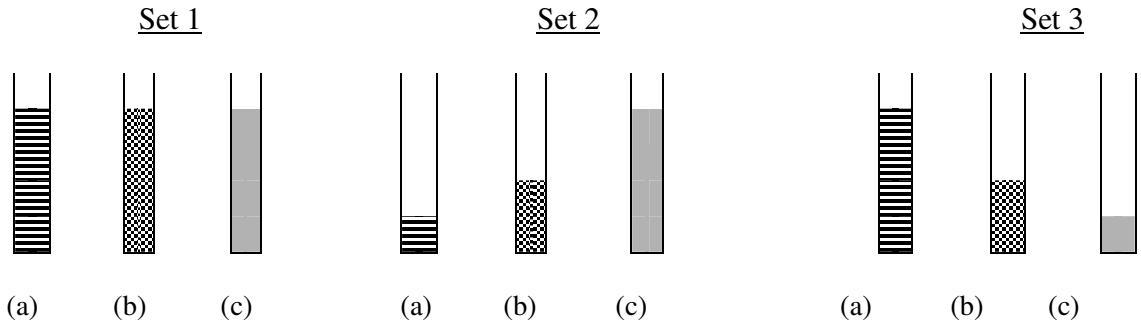
6.3 If you are definitely sure of the answer, or you are sure that you have correctly worked out the answer, then you are 100% sure of the correct answer!

7. Hand in the answer book at the end.

---------- GOOD LUCK!----------

QUESTION 1

Which of these three sets best shows 1 mole of tin, 1 mole of magnesium and 1 mole of sulphur in each tube.



(a) - tin
(b) - magnesium
(c) - sulphur

key: Set 1 - equal volumes
Set 2 - equal masses
Set 3 - equal number of atoms

Give a reason/s for your answer below:

Indicate your level of confidence (how sure are you that you are correct?)

0%	50%	100%

QUESTION 2

Each container represents a volume of 22,4*l* at S.T.P. In which of the three pairs of containers, if any, is there one mole in each container?

$N_{2(g)}$	$H_{2(g)}$	$O_{2(g)}$	$Hg_{(l)}$	$SO_{2(g)}$	$S_{(s)}$
red containers		blue containers		green containers	

Write your answer below. Give reasons for your choice as well as for not choosing others.

Indicate your level of confidence (how sure are you that you are correct?)

0%	50%	100%

APPENDIX E

CLASSROOM OBSERVATION (adapted from ELRC, 2003)

Performance standard 1: Knowledge of curriculum and learning programmes

Expectation: The educator possesses appropriate content knowledge that is demonstrated in the creation of meaningful learning experiences

Question: does the educator demonstrate adequate knowledge of the Natural Science learning area or Physical Science subject and does s/he use this knowledge effectively to create meaningful experiences for learners in grade 9/10?

CRITERIA: (a) Knowledge of learning area/subject (b) skills (c) goal setting (d) involvement in learning programmes

Levels of performance	
1	Unacceptable
(a)	Educator conveys inaccurate and limited knowledge of learning area/subject
(b)	No skill in creating enjoyable learning experiences for learners
(c)	Little or no evidence of goal-setting to achieve curriculum outcomes
(d)	Makes no attempt to interpret the learning programmes for the benefit of learners
2	Satisfies minimum expectations
(a)	Educator's knowledge is adequate but not comprehensive.
(b)	Has some skill in engaging learners and relating the learning programme to learners' needs.
(c)	Evidence of some goal setting to achieve curriculum outcomes
(d)	Makes some attempt to interpret the learning programmes for the benefit of learners
3	Good
(a)	Educator is able to use knowledge and information to extend the knowledge of learners
(b)	Educator skilfully involves learners in learning area
(c)	Makes every endeavour to set realistic goals to achieve curriculum outcomes
(d)	Displays great enthusiasm in interpreting learning programmes in the interest of learners
4	Outstanding
(a)	Educator uses knowledge to diagnose learner strengths and weaknesses in order to develop teaching strategies
(b)	Educator uses learner-centred techniques that provide for acquisition of basic skills and knowledge and promotes critical thinking and problem solving
(c)	Curriculum outcomes are always achieved by being creative and innovative in the setting of goals
(d)	Excellent balance between clarity of goals of learning programmes and expression of learner needs, interests and background

APPENDIX E (Continued)

CLASSROOM OBSERVATION

Performance standard 2: Lesson planning, preparation and presentation

Expectation: The educator demonstrates competence in planning preparation, presentation and management of learning programmes

Question: Is lesson planning clear, logical and sequential and is there evidence that individual lessons fit into a broader learning programme?

CRITERIA: (a) Planning (b) Presentation (c) Recording (d) Management of learning programmes

Levels of performance	
1	Unacceptable
(a)	Little or no evidence of lesson planning
(b)	Lesson not presented clearly
(c)	No records are kept
(d)	Learners not involved in lessons in a way that supports their needs and the development of their skills and knowledge
2	Satisfies minimum expectations
(a)	Lesson planning not fully on a professional standard
(b)	Lessons are structured and relatively clearly presented
(c)	Evidence of essential records of planning and learner progress is available
(d)	Evidence of some learner involvement in lessons in a way that it supports their needs and the development of their skills and knowledge
3	Good
(a)	Lesson planning is generally clear, logical and sequential
(b)	Lessons are well structured and fit into the broader learning programme building on previous lessons and anticipating future learning activities
(c)	Essential records of planning and learning progress are maintained at a high level of proficiency
(d)	Good involvement of learners in lessons in such a way that it supports their needs and the development of their skills and knowledge

4	Outstanding
(a)	Lesson planning is abundantly clear, logical, sequential and developmental
(b)	Outstanding planning of lessons that are exceptionally well structured and clearly fits into the broader learning programme with evidence that it builds on previous lessons as well as fully anticipating future learning activities
(c)	Outstanding record keeping of planning and learner progress
(d)	Excellent involvement of learners in lessons in such a way that it fully supports their needs and the development of their skills and knowledge

APPENDIX F

GRADE 10 LESSON PLAN(DoE, 2006(b))

KNOWLEDGE AREA: CHEMICAL CHANGE		**THEME**	
DATE		Physical and Chemical change Representing chemical change	
DURATION			
CORE CONCEPTS			
LEARNING OUTCOMES		LO 1: Practical Scientific Inquiry and Problem solving skills	
		LO2: Constructing and applying Scientific knowledge	
		LO3: The Nature of Science and its relationship to Technology, Society and the Environment	

ASSESSMENT STANDARDS		
1.1	Conducting an investigation	
1.2	Interpreting data to draw conclusions	
1.3	Solving problems	
1.4	Communicating and presenting information and scientific arguments	
2.1	Recalling and stating specified concepts	
2.2	Indicating and explaining relationships	
2.3	Applying scientific knowledge	
3.1	Evaluating knowledge claims and science's inability to stand in isolation from other fields	
3.2	Evaluating the impact of science on human development	
3.3	Evaluating science's impact on the environment and sustainable development	

TEACHING ACTIVITIES

TEACHING METHODS					
Other:	Explanation		Practical demonstration		
	Jigsaw assignment		Practical group work		
	Debate		Reading time		
	Report back		Problem solving		
	Field trip		Viewing multi-media		

INTERGRATION		**SKILLS**		**VALUES & ATTITUDES**	
Mathematics		Classifying & communicating		Team work	
Math. Literacy		Critical thinking & problem solving		Appreciation	
Life Sciences		Drawing conclusions		Co-operation	
Life Orientation		Identifying and controlling variables		Responsibility	
Geography		Evaluating conclusions		Accountability	
Business Studies		Hypothesising		Empathy	
Civil Technology		Measuring		Self-esteem	
Electrical Technology		Observing & comparing		Endurance	
Mechanical Technology		Predicting			

APPENDIX F (Continued)

EXPANDED OPPORTUNITIES				**LTSM**	
Provide extra time for the slower learner				Laboratory equipment	
Provide large print reading for learner with visual problems				Projector/Blackboard	
Individual attention				Mult-media	
Study method assistance				Specialist guide (workbook)	
Extra work and reading material for advanced learners					
ASSESSMENT FORMS				**ASSESSMENT TOOLS**	
Daily assessment		**Formal assessment**		Rubric	
Test		Practical		Memo	
Practical work		Control Test			
Research assignment		Research project		**Method of assessment**	
Homework assignment		Exam		Self	
				Peer/group	
				Teacher	

APPENDIX G: GRADE 10 PHYSICAL SCIENCE (NCS) (Hand-out from DoE, 2006(b))

<table>
<tr><th>MECHANICS 12,5%</th><th>WAVES, SOUND AND LIGHT 12,5%</th></tr>
<tr><td>

▪ <u>Motion in one dimension:</u>
• position, displacement, distance;
• speed, average velocity, instantaneous velocity;
• acceleration;
• description of motion in words, diagrams, graphs and equations;
• frames of reference.

▪ <u>Gravity and mechanical energy:</u>
• weight (force exerted by the earth on an object);
• acceleration due to gravity (acceleration resulting from the force exerted by the earth);
• gravitational potential energy;
• kinetic energy;
• mechanical energy (sum of gravitational potential energy and kinetic energy);
• conservation of mechanical energy (in the absence of dissipative forces)

</td><td>

▪ Transverse pulses on a string or spring:
• pulse length, amplitude, speed;
• graphs of particle position, displacement, velocity, acceleration;
• transmission and reflection at a boundary between two springs (or strings);
• relation of pulse speed to medium;
• reflection from a fixed end and a free end;
• superposition.

▪ <u>Transverse waves:</u>
• wavelength, frequency, amplitude, period, wave speed;
• particle position, displacement, velocity, acceleration;
• standing waves with rent boundary conditions (free and fixed end) as a kind of superposition.

▪ <u>Geometrical optics:</u>
• light rays;
• reflection;
• refraction (change of wave speed in different media);
• mirrors;
• total internal reflection, fibre optics in endoscopes and telecommunications.

</td></tr>
<tr><th>ELECTRICITY AND MAGNETISM 12,5%</th><th>CHEMICAL CHANGE
18,75%</th></tr>
<tr><td>

<u>Magnetism:</u>
• magnetic field of permanent magnets;
• poles of permanent magnets, attraction and repulsion;
• Earth's magnetic field, compass.

▪ <u>Electrostatics:</u>
• two kinds of charge;
• force between charges (descriptive);
• attraction between charged and uncharged objects (polarisation);
• conductors and insulators.

▪ <u>Electric circuits:</u>
• need for a closed circuit for charges to flow;
• electrical potential difference (voltage);
• current;
• resistance;
• principles and instruments of measurement of voltage (P.D.), current and resistance.

</td><td>

▪ <u>Physical and Chemical Change</u>
• Microscopic interpretation of macroscopic changes (for example changes in conductivity and temperature)
• Separation of particles in decomposition and synthesis reactions
• Conservation of atoms and mass.
• Law of constant composition
• Conservation of energy
• Volume relationships in gaseous reactions.

▪ <u>Representing chemical change</u>
• Balanced chemical equations

</td></tr>
</table>

APPENDIX G (Continued)

MATTER AND MATERIALS 25 %	CHEMICAL SYSTEMS 18,75 %
▪ **Observing, describing, classifying and using materials - a macroscopic view** • The material(s) of which an object is composed. • Mixtures: heterogeneous and homogeneous. • Pure substances: elements and compounds. • Names and formulae of substances. • Metals, semimetals and nonmetals. • Electrical conductors, semiconductors and insulators. • Thermal conductors and insulators. • Magnetic and nonmagnetic materials. ▪ **Particles substances are made of** • Atoms and molecules (simple and giant) • Linking macroscopic properties of materials to micro (particle) structure. • Intermolecular and intramolecular forces (chemical bonds). Physical state and density explained in terms of these forces. Particle kinetic energy and temperature. ▪ **The Atom: basic building block of all matter** • Models of the atom. • Atomic mass and diameter. • Structure of the atom: protons, neutrons, electrons. • Isotopes • Energy quantization and electron configuration. • Periodicity of ionization energy to support the arrangement of the atoms in the Periodic Table. • Successive ionization energies to provide evidence for the arrangement of electrons into core and valence electrons.	▪ **Global cycles:** * The water cycle: • Physical changes and energy transfers: The movement of water from the ocean and land surfaces as controlled by energy in sunlight. Reservoirs for water on Earth. • Macroscopic properties of the three phases of water related to their microscopic structure. * The nitrogen cycle: • Chemical changes and energy transfers. The movement of nitrogen between interrelated biological and geological systems. • Industrial fixation of nitrogen ▪ **The hydrosphere** * Its composition and interaction with other global systems. * Ions in aqueous solution: their interaction and effects. • Electrolytes and extent of ionization as measured by conductivity • Precipitation reactions.

APPENDIX H

Grade 10 Physical Science Lessons 1& 2 15 March 2006

Duration: 60 minutes

Teacher: Today we'll be talking about different ..... and before we start we need to know that at the end of this lesson ... which ... or what we should be able to know: First when we end this lesson we should be able to know: **what is matter** (*writing on the chalkboard nervously*), we should be able to know what are **mixtures,** we should be able to know what are **elements**, we should be able to know what are **compounds, homogeneous mixtures**, and ... **heterogeneous mixtures**, we should be able to know **suspension.** These are the following concepts that we are going to deal with ... for this lesson of today (*pointing at the chalk board*).

Now, from previous classes I know that you have learned about what we call **matter**. What did we say **matter** was from previous classes?

Student: Matter is everything that occupies space and has mass
Teacher: Matter is everything or anything that occupies space ... and has mass (*as he writes on the chalkboard*) So, in chemistry study, we'll be studying about the matters ... we'll be studying about anything that occupies space and has mass and how they change. For instance: substances have a certain composition ... we differentiate them according to how they react. We have what we call **element**, **compound** and **mixtures** (*writes again on the board*). As we start, the elements, they are those substances that cannot be broken down into simpler substances; we cannot be able to separate them by physical means or by chemical means. Mixtures are substances that we can physically separate. For instance – air is a mixture; it's a mixture of hydrogen and oxygen; so we can be able to separate them. Even the compounds – compounds we can be able to separate them by (*into*) smaller particles.

Let's take examples of mixtures. Let's start with mixtures: If I take salt and mix it with water (*writes on the board*). I'm going to have a what? I am going to have a mixture! *Not so?*
Students (in chorus): Yes!
Teacher: And that mixture is called a clear mixture because water and salt can completely dissolve inside the what?
Students (in chorus with the teacher): Water!
Teacher: By virtue of the fact that water has ... mixed completely we say that the mixture is clear. There are some other elements that you are going to learn about, like copper sulphate. Copper sulphate is ... a colour. Although it has a colour, it can completely (*got stuck*) ... we call it a clear ... it is clear because although it has colour, but it can dissolve inside the water. Not so!
Students (in chorus): Yes
Teacher: Let us further move on to what we call homogeneous mixtures. Homogeneous mixtures, as I have made an example of water and salt, they are able to dissolve inside each other. But heterogeneous mixtures; let's say you take sand and mix it with what; with irons (iron filings). Can they completely mix?

Students (in chorus): No
Teacher: Why?
One student: They are both solids
Another student: One cannot dissolve in the other

Teacher: They are both solids. One cannot dissolve in the other (*repeating what the students said*). And if I were to take a magnet, would I be able to separate the sand from the iron filings?
Students (in chorus): Yes
Teacher: So, then, heterogeneous mixtures are mixtures of substances that cannot completely mix with each other. Number two – **suspension** (*writes it again on the board*). Let's say you mix sand with water, and then you stir it. What is going to happen?
Student: (*Inaudible)*
Teacher: Can you say that it will dissolve. Dissolve in water?
Students (in chorus): No
Teacher: It does not dissolve in water. So, if you were to take the very same container and put sand inside and mix it with ... *water*, it will definitely not dissolve in water but for us to have this suspension, I can be able to separate sand particles from water. I can use my container together with my funnel and filter paper. If I use my funnel to separate the water from the sand ... I will be able to separate the water and the sand. What will be left here on the filter paper will be the sand (*pointing to the drawing on the chalkboard).* Not so! And the sand ... we call it the **residue.** Let us take examples ..., a practical example of everyday that we see of homogeneous mixtures and heterogeneous mixtures. Let's start with homogeneous mixtures; number one:
I said a combination of hydrogen and oxygen, what does it give us; It gives us **water**. Can you see what was hydrogen, what was oxygen?

Students (in chorus): No!
Teacher: It is a homogeneous mixture. **Water** is an example of a **homogeneous mixture** because you cannot be able to see. Give me more examples of homogeneous mixtures that you see everyday.
Student: A coffee and hot water
Teacher: Mmmm... she is saying a coffee and hot water. Is it a homogeneous mixture?
Students: (*some say yes and others say no)*
Teacher: I agree with her. Coffee in a hot water is an example of a homogeneous mixture (*writes on the chalkboard*). Come with your own examples (*calls a few students by name and urges them to answer*)
One student: Water and Sweet Aid (*A popular drink*)
Teacher: Water and Sweet Aid is an example of homogeneous mixture (*writes on the board*). *When we come to* the examples of heterogeneous mixtures. Heterogeneous mixtures: inside a can of aerosol, there are two substances; what are the two substances; it's a combination of a gas and a liquid. There are three phases of matter, gas, liquid and solid. So, a homogeneous mixture is a combination of a gas and liquid in a form of a spray. Some of us Ego and others use Shield – these are examples of a homogeneous mixture. Before we go any further, are there any questions?
Student: In examples of homogeneous mixtures, do we always use water? Can you give an example without using water?
Teacher: Remember we have three phases of matter; it's either you can be able to mix liquid and solid or solid solid ... any example that will be able to be soluble ... that will combine completely ... remember homogeneous are those that can combine completely without eh ... in other words they are soluble ... they combine and they don't ... but homogeneous are those that cannot be separated easily ... yes my girl (*diverting attention to another student who had just raised her hand*).
Student: ... how do you separate them?

Teacher: You can separate them through chemical means. Let's take an example of water and salt. If you heat the solution for a long time, the salt will remain inside the container.
(There were sustained grumblings from the learners. Then there was a question from a student that was inaudible. The teacher ruled it irrelevant to the subject matter).

Now; I have examples here; I want you together with your partner to separate them into homogeneous and heterogeneous (*he wrote on the chalkboard: ink, milk, salt and water, tea, sand and water. The teacher then went around the class checking on learners as they went through the class work. The class was very rowdy. Towards the end of the period, he gave learners some homework: he asked them to look for five different products at home and identify their components from the labels, their % composition and then classify the components as solid, liquid or gas. Lastly they must state if they were harmful or not. That was the end of the lesson).*

In a repeat lesson in another classroom, he added the concept of **emulsions.**

APPENDIX I:

Grade 10 Physical Science Lessons 7 & 8 Date: 12 May 2006

Duration: 60 minutes

Teacher: Mercury is liquid at room temperature. All metals except mercury are solids. They have high melting points. If you melt them in the end, they will melt. *(What the teacher writes on the chalkboard is given in bold)*

1. So, except for mercury, the **metals are solid**
2. Another property of metals that they share, that they are in common with, is that **metals are shiny**. Metals have a tendency of being shiny; they are easily polishable. You can be able to polish them.
3. **Metals are malleable** – now, malleable simply means that they can be able to bend, they can be able to ... make them into any shape that you want with them.
4. Metals are very strong hence we use them for heavy duties (*writes on the chalk board*). **Metals are good conductors of electricity**. It's quite obvious, although sometimes we never realise, that the cables that comes to our homes, are made of metals. They are made of silver and copper; but the ones that are on our televisions, our radios they made of copper – so they are good conductors of electricity.
5. **They are also good conductors of heat**. Inside our kettles we use steel; inside the pot that we use everyday there is steel ... therefore they conduct heat. They are good conductors of heat. *Very inaudible sentence.*

The combination of metals and the non-metals is what we call **metalloids**. The darker part of the Periodic Table are the **non-metals** (*pointing to the Periodic Table*). Number ... the line that goes ... number 15... no ... number 5 *(referring to the atomic number as he points to the Periodic Table)*, number 14 which is silicon, boron, silicon, arsenic ... eh ... antimony... eh ... tellurium, polonium, astatine ... they are all metalloids. If you look at ... on top of eh ... number 1 ... the number 1 element ... eh ... hydrogen ... it's also indicating it's also a non-metal. Lithium, beryllium, all this ... sodium, magnesium, all of this ... they are **metals**. They are all metals. Now, if ... what is the fun of learning these particular metals everyday? *(No answer from students).* We've got to know what their day-to-day use *is* – what do we use them *for*. How do we use them every day in our lives? How do we use sodium, how do we use magnesium in our every day life?

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APPENDIX I (Continued)

We use different metals in our every day lives. So, we are going to look at the uses of some of those metals. Let us look at sodium. Sodium in conjunction with other metals – we use it everyday:

1. Sodium in conjunction with chloride gives us something that we use everyday. What do you think that is?

Student: Salt.

Teacher: Salt. Sodium plus chloride gives us a salt.

2. Sodium plus oxygen plus hydrogen gives us sodium hydro-oxide. *Inaudible.* Usually when our drains are blocked, we use it – caustic soda. We also use a variety of other elements – for instance, we use (number 3)
3. Lithium in conjunction with carbon: Lithium carbonate. We use lithium carbonate – what do we use it for? We use it in making drugs – by drugs I don't mean the bad ones. *Inaudible*. We use lithium carbonate for *metally ill patients*.
4. We use gold – what do we use gold for?

Student: Jewellery.

Teacher: Jewellery.

5. Titanium – we use it mostly to build aircraft. *Inaudible. We also use it in making batteries.*

We use most of these elements each and every day of our lives, without being aware that we are using them. So, every time you see them or taste, you must be curious about whether some of the elements you have learnt about are being used

At this stage the teacher circulated samples of sodium and magnesium through the class. Learners became very rowdy as they awaited their turn to see the samples. It took about 10- 15 minutes for the samples to be seen by all.

Teacher: Now, while you are looking at that, I have written some of the names here of the elements. You are going to do your investigation now over the weekend. I want it on Monday. You do it on the exam paper; we are going to file it for your portfolio.

You are going to investigate ... what is sodium hydrogen carbonate; you are going to look at which product contains sodium hydrogen carbonate and what you use that product for. There are six of those that you are going to look at.

APPENDIX J: INTERVIEW TRANSCRIPTS

Liza Eddington

No	STATEMENT	Code
1	I: What is your favourite subject in the FET phase?	
2	S: If I may say… ehm… you said the FET phase?	
3	I: Grade 10, 11, 12	
4	S: … it has to be Life Science… because… eh …my career… the career that I'm following has to do with the things that we are told in Life Sciences … meaning that my career … I want to be a doctor … so I think that my career depends on it mostly.	-1
5	I: Is your interest in science declining, increasing or remaining the same as you move from GET to FET?	
6	S: Actually at the moment it is decreasing, but then I know that I will pull up again, but at the moment it is decreasing	-1
7	I: What would you say is the reason	
8	S: I think that the things I was told before, were not that hard than now… things are changing and getting more difficult and I'm getting used to that… and the changing of teachers … last year we were taught by teacher X now this year we are taught … they have changed teachers, so I was used to teacher X from grade 10 and 11 but now they have changed him and so I think that is my problem.	
9	I: OK. Coming to the teacher-student relationship, how do you compare your relationship with your science teacher in grade 7,8 and 9 with the relationship with your science teachers in grade 10, 11 and 12?	
10	S: In grade 7 to 9 it was very good, it was very good because as I said before I was very good in those subjects but now it's good but not that good. It's not good because of what I've just said.	-1
11	I: Is the way science taught in the FET phase meeting your expectations?	
12	S: Yes, it does, it does 'cause the things that they are teaching now are the things that I want to know more …. you know … that is my expectation.	+1
13	I: In your own words, how would you describe the transition from the GET phase to the FET phase focusing on the transition from the Natural Science to Physical Science	
14	S: I don't know…	
15	I: Are you saying that you are not able to describe it?	
16	S: Yes, that is what I'm saying	

No	STATEMENT	Code
17	I: Would you say it's the same or would you say it's different…	
18	S: It's very different, it's very different, because… things are now changing and being more difficult because … in grade 7, 8 and 9 things were simple then … you were learning simple stuff and you would understand easily, but in grade 10, 11, 12 theirs were a bit difficult but then … I think that's the way things should be, you know.	-1
19	I: Now, I would like you to answer questions on the diagnostic test that I gave you. In the first question, I wanted you to choose: 'Which of these three sets best shows 1 mole of tin, 1 mole of magnesium and 1 mole of sulphur in each tube'; and you chose set 2. Can you give reasons why you chose set 2?	
20	S: I chose set 2 because … Mg is higher than S or Sn, their masses are equal but their volumes … I thought they were not equal	-1
21	I: What do you understand by a mole?	
22	S: Actually nothing … nothing	-1
23	I: Ok. Let's come to the second question: Here you chose red containers. Can you give reasons why you chose red containers?	
24	S: I chose red containers because I thought that the … their volume, they were having the same volume	
25	I: All of them have the same volume … 22.4 dm^3 at S.T.P	
26	S: Oh, yeah! … I thought that … because nitrogen has 2 … 2 nitrogen and 2 hydrogen, so they will have 1 mole in each	0
27	I: Thank you	

Linda Epson

No	STATEMENT	Code
1	I: What is your favourite subject in the FET phase	
2	S: My favourite subject in the FET phase is Life Science	-1
3	I: Can you tell me why?	
4	S: Because in Life Science we learn more about human bodies … it teaches us about things that we don't know	
5	I: Ok. What career would you like to follow?	
6	S: Metro police.	-1
7	I: Can you give me the reason why?	
8	S: If you look at most people working in the Metro police, there are no females … it's mainly males. I like the Metro police a lot because…it teaches people a lot: if you are a woman, you are a woman	
9	I: Tell me: Is your interest in science declining, increasing or remaining the same as you move from the GET phase to the FET phase?	
10	S: No, it's decreasing, because in grade 9 it was better than this year, 'cause it's so difficult for me	-1
11	I: How do you compare your relationship with your science teachers in grade 7,8 and 9 with the relationship with your science teachers in grade 10, 11 and 12?	
12	S: The relationship that I have in grade 9, 10 teachers was not like the teacher I got now in grade 11 and 12 … *the one who teaches me now is better because he is also my class teacher … and we can talk … but it was difficult to approach the others … the present one is approachable*	+1
13	I: Ok. Is the way science taught in the FET phase meeting your expectations? … Is the way the teacher is teaching science in grade 10, 11 and 12 meeting your expectations … is it what you expected?	
14	S: No. *In grade 9 lessons were easier to follow, but in grades 10, 11 and 12 it's becoming more difficult.*	-1
15	I: In your own words, how would you describe the transition from the GET phase to the FET phase focusing on the transition from the Natural Science to Physical Science	

No	STATEMENT	Code
16	S: *I think Physical Science is difficult*	-1
17	I: Let's come to the diagnostic test that I gave you … please explain how you came to your answer. In the first question I asked you: 'Which of these three sets best shows 1 mole of tin , 1 mole of magnesium and 1 mole of sulphur in each tube?' and you chose set 2. Why?	
18	S: I chose set 2 because I saw .. eh.. equal volume, equal mass and equal number of atoms. Then I think it was the right answer.	-1
19	I: What do you understand by a mole?	
20	S: I understand that a mole … is something that … they use it mostly in Physical Science … maybe to describe … I think sulphur, magnesium … I think they are using chemical or electrical chemistry	-1
21	I: Ok … let's come to the last question: in this second question I asked you: 'Each container represents a volume of 22,4 *l* at S.T.P. In which of the three pairs of containers, if any, is there one mole in each container?'	
22	S: I chose the red container because I think the blue container and the green container are representing the S.T.P. containers	-1
23	I: Thank you	

Henry Els

No	STATEMENT	Code
1	I: Tell me, what is your favourite subject in the FET phase?	
2	S: It's Mathematics	-1
3	I: Why Mathematics	
4	S: Actually I have a passion with .. like playing with numbers and all that	
5	I: What career would you like to follow?	
6	S: I would like to follow computer sciences … since I found that …I have love for computers …then I decided that … let me rather choose a career which involves computers a lot.	-1
7	I: Is your interest in science declining, increasing or remaining the same as you move from the GET phase to the FET phase?	
8	S: It's declining.	-1
9	I: Can you give me reasons why?	
10	S: Basically, from the GET section… the teachers there … they were like … trying to explain most of the stuff … and we didn't like expect the way we are being taught now	
11	I: How do you compare the relationship with your science teachers in grade 7,8 and 9 with your relationship with your science teachers in grade 10, 11 and 12.	
12	S: It's different … because …from the early grades .. teachers try to make us have more love for science rather than the ones we have right now. In the FET section, they come to class, teach you and the other work is for you to do	-1
13	I: Ok. Is the way science taught in the FET phase meeting your expectations?	
14	S: No, it's not	-1
15	I: Can you explain?	
16	S: When you have to do certain parts, especially in chemistry … that's where you have to do experiments .. so you find out that the school does not have enough material to help us out .. so you end up doing the experiment as part of theory.	
17	I: In your own words, how do you describe the transition from the GET to the FET phase, focusing on the transition from Natural Science to Physical Science	

No	STATEMENT	Code
18	S: I would say it's more like going to university but you're still at school … in grade 9 we were told … grade 9 is like grade 12… the way we are being assessed …so… moving to grade 10 … was more like you were doing your first year … doing your first year in matric.	-1
19	I: Ok. Let's now come to the diagnostic test that I gave to you. You chose set 2. Can you explain why?	
20	S: Choosing set 2 … I had confusion dealing with chemistry. ..if they are having equal masses … then the number of moles must be equal … rather than sticking to: if they have equal volumes … equal volumes does not mean that they will always have equal number of moles … because you may find that one may be a solid while the other one is a gas.	0
21	I: Tell me – what do you understand by a mole?	
22	S: It's a certain quantity of a substance … whereby if you do an experiment … you have to consider how much you put in. The other way of putting it …it's like dealing with concentrations .. but …by moles we deal with … the quantity	0
23	I: Let's come to question 2… you gave, as your answer: the red containers have one mole in each. Why did you choose red container	
24	S: I chose it because … when in class we were doing .. balancing the equations … we were told that … in front of an element …the number in front represents … the coefficient .. represents the number of moles.. then .. if nitrogen gas and hydrogen gas … that would mean that … they have equal number of moles … meaning that … each one has one compared to the other containers	0
25	I: Let's take example… oxygen and mercury … explain why you didn't choose blue containers	
26	S: Since oxygen is a gas and mercury is a liquid, if both of them were put together, it wouldn't make one mole …since the other one is liquid … it's like if you put gas in water, eventually there will be a reaction between the two.	0
27	I: OK. Thank you very much.	

Hazel Planck

No	STATEMENT	Code
1	I: What is your favourite subject in the FET phase	
2	S: My favourite subject is Mathematics because in Mathematics we do more with figures … and you have to calculate … it's not all about cramming the notes you are given … you have to know your subject and you have to practice	-1
3	I: What career would you like to follow?	
4	S: I'd like to be an actuarial scientist, because as an actuarial scientist … it deals with figures and statistics, and you also have to engage with the community; get to know more about the … where the country is going in terms of its commercial/ financial status.	-1
5	I: Is your interest in science declining, increasing or remaining the same as you move from the GET phase to the FET phase?	
6	S: My interest in science is declining because in the FET phase it's more complicated. I think the work is more and you have to memorise all these terms. It's more work and the chemistry part … I like the chemistry part as I was doing grade 9 and grade 8 but as I got to grade 10 it was more difficult because there was a bit of change in the way it was taught and the way I understood it; and the other thing is that we don't have laboratory so we have to read the experiment from the text-book and cram it	-1
7	I: How do you compare your relationship with your science teachers in grade 7, 8 and 9 with your relationship with your science teachers in grade 10, 11 and 12.	
8	S: The relationship I have with my science teachers in grade 11 and 12 is more good because … we engage more … they guide us about our future … they do some kind of guidance in terms of career choices .. they tell us about our level of intelligence in terms of science and they tell us which career to follow … they give us a choice … whereas in grade 8 and 9 it was all about theory … they teach the subject but you do not know what you are going to do with it when you finish school.	+1
9	I: Is the way science taught in the FET phase meeting your expectations?	

No	STATEMENT	Code
10	S: No, it is not, because when I was in grade 8 and 9 we did a lot of experiments … science was more of a practical subject but as we get to grade 10 we get stories like a … things that we have to do like experiments … they are expensive and we can no longer do them …so science is now more like …you have to cram and … know terms by heart without actually seeing the things you are talking about.	-1
11	I: In your own words, how do you describe the transition, that is movement from the GET phase to the FET phase focusing on the transition from Natural Science to Physical Science	
12	S: Well … when you go to the FET phase … there is more work … it is more difficult. I think in the lower grades they prepared us for is change because we used to write assignments and we did a lot of essays - maybe about a page but when we get to FET we have to write about three pages or four pages … it is more work … but it is in a good way because in the GET we were prepared for that	-1
13	I: Now, Nonhlanhla, let's come to the diagnostic test that you wrote. It was based on the mole concept. Explain why you chose set 3.	
14	S: The reason why I chose set 3 …I looked at the beakers in terms of the volumes … the number of atoms which are in the beakers … so I looked at the beakers and then I compared set 1,2 and 3 … I looked at them in sequence …in set one they are full and they decrease again in set 2 and set 3 again … the beaker is still the same while the 3 beakers decreased	-1
15	I: Let's look now at the second question. In the second question: why did you choose red containers	
16	S: I chose red containers because … both elements are gases while in the blue containers you've got a liquid and you also have a solid (*pointing to sulphur in the green containers).* It's just because of the gases	+1
17	I: I see that you have 0% level of confidence – are you sure that you are correct?	

No	STATEMENT	Code
18	S: No, I am not sure that I'm correct – I just used common sense because here at school we are not actually taught … chemistry …. we do a lot of the Physics part …. the calculations …. Not the chemistry part because it includes experiments	
19	I: Thank you very much	

Howard Prins

No	STATEMENT	Code
1	I: What is your favourite subject in the FET phase?	
2	S: Science	+1
3	I: Will you explain why science?	
4	S: Because … in science … I'm very good in science but again it's a subject that I found very interesting and which I wanted to pursue later on in future	
5	I: What career would you like to follow?	
6	S: Mining engineering	+1
7	I: Will you explain why mining engineering?	
8	S: Mining engineering is a very interesting field. In mining you deal with extraction of metals. The company which uses metals is the company that I want to work for … I'm interested with working with the elements of the Periodic Table.	
9	I: Is your interest in science declining, increasing or remaining the same as you move from the GET phase to the FET phase?	
10	S: It's increasing since I find it more interesting even though it's hard sometimes but I try to meet the standards of science.	+1
11	I: How do you compare your relationship with your science teachers in grade 7, 8 and 9 with your science teachers in grades 10, 11 and 12?	
12	S: Now the science teachers are a bit harsh about the work and in grade 7 grade 6, they were just teaching you everything, but now they tell you: the reason you are doing science is because you wanna be someone. So they teach you in such a way that you become interested more and more in science.	-1
13	I: Is the way science taught in the FET phase meeting your expectations?	
14	S: No it's not, because most of the time we only do theory and we don't normally use the labs, especially in chemistry for practical so you can understand more if you do practical but when you only do theory sometimes it's hard to understand	-1

No	STATEMENT	Code
15	I: In your own words, how would you describe the transition from the GET phase to the FET phase focusing attention on the transition from Natural Science to Physical Science.	
16	S :Natural Science was just basic things, something like general knowledge but now when you come to FET there are laws … Newton's Laws and everything. Before you do anything in science you have to understand the concepts first. So, it's hard yeah, it's hard.	-1
17	I: Now, let's get to the diagnostic test. In the first question you chose set 3. Please explain why you chose set 3.	
18	S: Because in set 3 they said they are equal atoms – and the question said: in which of the containers had one mole so if ever the container has equal … the atoms are equal … when they are about to bond … it means there was one mole, one mole one mole in each before the reaction	-1
19	I: Before which reaction?	
20	S: It's tin, magnesium and sulphur, so in each of the sets they are … ok, this one is one mole one mole one mole, if ever you are doing a reaction, let's say nitrogen and hydrogen then you use one mole one mole to give you the forward reaction	
21	I: Let's come to the second question. Explain why you chose green containers	
22	S: Sulphur has one mole but it has two atoms of oxygen, that's the main reason why I chose green containers	-1
23	I: Tell me, what do you understand by a mole?	
24	S: I think it's the number of atoms which are needed for a particular reaction to happen	0
25	I: Thank you	

Humphrey Edwards

No	STATEMENT	Code
1	I: What is your favourite subject in the FET phase	
2	S: Actually it's English	-1
3	I: Explain why English	
4	S: It's English because… actually I like novels … I like books much … we get to do books and in those books we get life skills … like for instance the book we are doing Maru – it takes you through a journey of somebody, then you get to learn such things.	
5	I: What career would you like to follow?	
6	S: Metallurgical science …in fact it's between metallurgical science and electrical science but I think I love metallurgy most.	+1
7	I: Is your interest in science declining, increasing or remaining the same as you move from the GET phase to the FET phase.	
8	S: I think it is increasing because from grade 10 to grade 12 we were introduced into new things like for instance momentum and the rates of reactions … you get to know how something happened that I did not understand how they occurred … but now through science I understand why is it that all things go down and not up … so I think being introduced to new things … things that are related to everyday life … I think it is increasing.	+1
9	I: How do you compare your relationship with your science teachers in grades 7, 8 and 9 with your science teachers in grades 10, 11 and 12?	
10	S: I think from grade 10 downwards, the relationship was kind of a parent and child .. because we were not .. they still took us as children .. . like they had to guide us … talk to us … understand us but since from grade 10 to grade 12 sometimes we were taught by an HOD … he's got a lot of duties so actually he just comes to teach you … you only have time to talk in class because they teach different classes and some are deputy principals they have to do some things … so it's kind of a distant relationship	-1
11	I: Is the way science taught at the FET phase meeting your expectations?	

No	STATEMENT	Code
12	S: Yeah I think so because in most cases you are taught something for instance you are taught Le Chaterlier's Principle and after you perform an experiment to prove whatever you have been told. In FET, no before, grade 7 downwards you were only taught something, volcano, combustion …. But now there are experiments you can perform to prove what you have been taught	+1
13	I: In your own words how do you describe the transition from the GET to the FET phase focusing on the transition from Natural Science to Physical Science	
14	S: I think the transition was big, because the way I understand it, Natural Science was the combination of Biology and Physics so in the FET phase like this they put them into two. In Physics we use formulas and everything and in Natural Science we deal with things like volcano … we focused more in the theoretical part. But now in the FET you have to know your theory together with your calculations and you get to be told new things that you didn't know, that you were not taught and some of the things are abandoned from grade 7 and in grade 10 you do new things.	-1
15	I: Now coming to the diagnostic test: explain why you chose set 1?	
16	S: I chose set 1 because … first of all we are just given the number of moles which is 1and we are not given the quantity of the volume so I decided to make the volume of each container to be 1, then I took the formula n = V/Vr Vr which is the S.T.P … I took the volume of each container to be equal to that of the S.T.P then I used the formula n = V/Vr which then I got 1… and because now the moles of tin, mole of magnesium and sulphur were each taken to be one … so then I did one calculation and concluded that all of them in set 1 must be 1 because I assumed that … the volume of each container must be equal to that of the S.T.P. That's the reason I chose set 1	0
17	I: What do you understand by a mole?	

No	STATEMENT	Code
18	S: A mole is …we calculate things in masses like for instance we've got kilograms, we've got grams and we've got milligrams but in science in most cases we experiment using smaller quantities … we take grams and convert it to molar … in a form of moles, so that it cannot be in that large number like kilograms	0
19	I: In the second question: explain why you chose green containers	
20	S: I chose the green container … I used the oxidation theorem … I used the valency numbers … I tried to find the oxidation number for oxygen in each container … then I found the oxidation number of SO_2 to be 2,5 and then again I found the … I found it to be 2,5 in both cases … then I said it is the green container because the number of moles in each container is the same … because the ratio of oxygen in each container is the same … so I concluded that the number of moles is the same both in the … due to the calculation that I have made.	-1
21	I: Have you ever heard of Avogadro's hypothesis?	
22	S: Avogadro's hypothesis? I think I've heard of … no, I think I just heard of it in passing … I've never like told in details	
23	I: Thank you	

Louisa Ericsson

No	STATEMENT	Code
1	I: What is your favourite subject in the FET phase?	
2	S: My favourite subject is Biology	-1
3	I: Will you explain why Biology?	
4	S: Biology is kind of interesting to me … I want to pursue a career that falls under Biology … which is gynaecology … because I'm more interested in knowing a woman's body; so, I do like Biology	-1
5	I: Ok. Is your interest in science declining, increasing or remaining the same as you move from the GET phase to the FET phase?	
6	S: It is declining, because in … what was the phase?	-1
7	I: The GET phase	
8	S: The GET phase … it was more simpler than this phase I'm in now. *I think it is also because what we did then is not the same as what we are presently doing because of the change in curriculum*	
9	I: How do you compare your relationship with your science teachers in grades 7,8 and 9 with your science teachers in grades 10, 11 and 12?	
10	S: *There is a difference … the teachers in grade 10 were different and are not the same as the teacher I have now … they have different teaching strategies*	0
11	I: Is the way science taught in the FET phase meeting your expectations?	
12	S: Yes, it does	+1
13	I: In your own words, how would you describe the transition from the GET to the FET phase focusing on the transition from Natural Science to Physical Science	
14	S: *In Natural Science things were much simpler. Right now we do many things that we did not do in Natural Science*.	-1
15	I: Ok. Let's now come to the diagnostic test. Explain why you chose set 1.	
16	S: *I chose set 1 because I realised that the molecules were equal so I thought that they had 1 molecule*	-1
17	I: What do you understand by a mole?	

No	STATEMENT	Code
18	S: A mole? I think … an element that can react with other element to form maybe.	-1
19	I: Tell me, why did you choose blue containers in the second question?	
20	S: Why I chose blue containers? Because both elements have a bigger number of mass … they contain less number of atoms … *I was using a Periodic Table when I answered this question … I found that one container had a gas and the other one consisted of a liquid. That's why*	-1
21	I: Have you ever heard of Avogadro's hypothesis	
22	S: NO	
23	I: Not at all?	
24	S: Not at all	
25	I: Have you ever heard of Avogadro's number?	
26	S: No	
27	I: Not at all?	
28	S: Not at all	
29	I: Thank you	

Lenah Edwards

No	STATEMENT	Code
1	I: What is your favourite subject in the FET phase?	
2	S: Life Orientation	-1
3	I: Explain why Life Orientation	
4	S: Because it is the most subject that I like	
5	I: Why , why like it?	
6	S: It deals with exercising and I like to exercise	
7	I: What career would you like to follow	
8	S: I would like to follow nursing	-1
9	I: Why would you like to follow nursing?	
10	S: I like to deal with health problems … I like to help sick people	
11	I: Is your interest in science declining, increasing or remaining the same?	
12	S: Decreasing … because I see that when I came from primary school to secondary school, the primary school and the high school is not the same; at high school it is the place where you have to work hard and know what you want in life	-1
13	I How do you compare your relationship with your science teachers in grade 7, 8 and 9 and your science teachers in grade 10, 11 and 12:	
14	S: I think they are the same, I don't see any difference	0
15	I: Is the way science taught in the FET phase meeting your expectations?	
16	S: I do not understand the question	
17	I: You are now doing Physical Science; you used to do Natural science in GET. In Physical Science .. is it the way you expect it to be taught	
18	S: No	-1
19	I: In your own words how would you describe movement from GET i.e. grade 9 downwards, to grade 10, 11, 12?	
20	S: In grade 9, 10, 11 is not the same as in grade 12 because in grade 12 … I think that is the grade that is the most difficult. And we have to work hard so that you can achieve your dreams or goals	-1
21	I: Ok. Let's come to the diagnostic test. In question 1 you chose set 2. Explain why you chose set 2.	

No	STATEMENT	Code
22	S: I was just thinking that in set 2 there was more concentration	-1
23	I: What do you understand by a mole?	
24	S: I think it's an element	-1
25	I: Ok. Let's get to the second question. Explain why you chose blue containers.	
26	S: I was thinking that I added the red container with the green container, they will remain the same as the blue colour container	-1
27	I: Have you ever heard of Avogadro's number?	
28	S: No	
29	I: Have you ever heard of Avogadro's hypothesis?	
30	S: No	
31	I: Ok. Thank you very much	

APPENDIX K

Examination content and weighting of LO's for grades 10 & 11 (DoE, 2005(c))

Weighting of the Learning Outcomes and specification of content across the two papers for the Grade 10 and 11 end-of-year examination (Department of Education, 2005)

		PAPER 1: PHYSICS FOCUS	**PAPER 2: CHEMISTRY FOCUS**
Duration		**3 hours**	**3 hours**
Maximum marks		**150 marks**	**150 marks**
Content		**Mechanics Waves, sound and light Electricity and magnetism Matter and materials Electronic properties of matter Atomic nuclei**	**Chemical change Chemical systems Matter and materials Atomic combinations: Molecular structure Ideal gases and thermal properties**
LEARNING OUTCOME		**WEIGHTING**	
Learning Outcome 1:	Practical scientific inquiry and problem-solving skills	30%	30%
Learning Outcome 2:	Constructing and applying scientific knowledge	40%	40%
Learning Outcome 3:	The nature of science and its relationship to technology, society and the environment	30%	30%

APPENDIX L

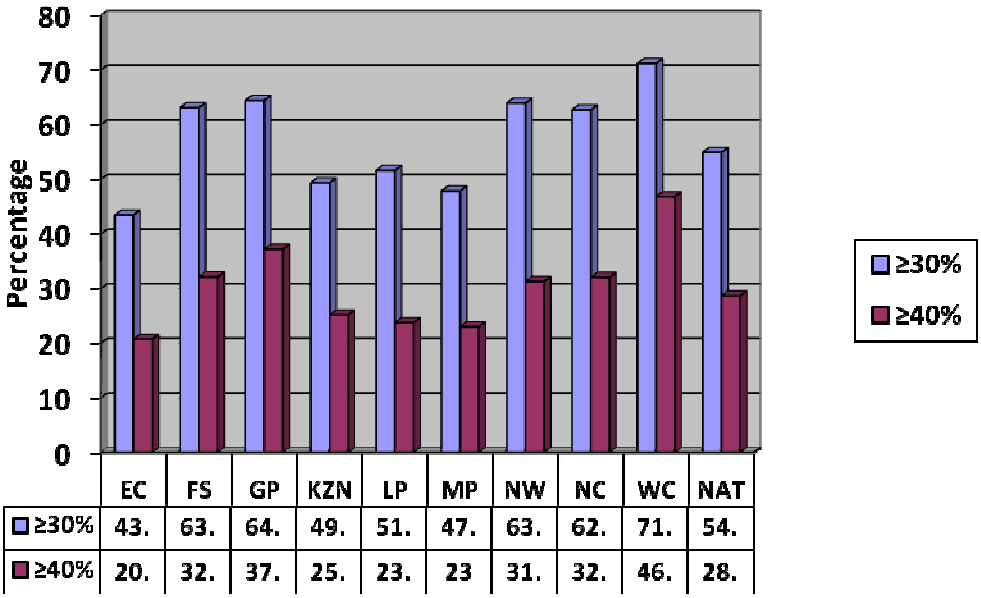
NATURAL SCIENCE: CORE KNOWLEDGE AND CONCEPTS – GRADE 9 NCS (Hand-out from GDE, 2006)

LIFE AND LIVING		
Life processes and healthy living	**Interaction in the environment**	**Biodiversity, change and continuity**
▪ **Human reproduction: What is reproduction** - **Fusion of sex cells** from mother and father, carrying the patterns for some characteristics of each - **Conception,** baby growth and development – growing and changing into adult - **Prevention of sexually** transmitted diseases including HIV/AIDS must be followed by behaviour choices ▪ Humans go through physical changes as they grow older**: Physical changes during puberty in boys and girls** ▪ **Excretion: Elimination of waste products** - Different organs that eliminate waste from the body: lungs, kidneys, skin and - The role of water in this process - Explain what is Homeostasis - **All living things depend on water passing through them in various ways, using structures such as kidneys, skin and stomata in plants** ▪ **Respiration: Breathing system** Oxygen which is provided by breathing system, reacts with food substances to release energy - Breathing organs - Cellular respiration ▪ **Circulatory system** - Parts of the circulatory system - What forms blood - Functions of the circulatory system – carries nutrients and oxygen to all parts of the body and remove waste products	▪ **Human reproduction** also involves adult raising children, which requires judgement and values and usually depends on the behaviour of other people in the community and environment	▪ **Conservation** **Causes of the loss of biodiversity: Human activities such as:** - Introduction of alien species - Habitat destruction - Population growth - Pollution **Extinction through natural events** ▪ **The cell** is the basics unit of most living things, and an organism can be formed from one or many cells. Cells themselves carry on life processes such as nutrition, respiration, excretion and reproduction, which sustain the life of an organism as a whole

<table>
<tr><td colspan="3">ENERGY AND CHANGE</td></tr>
<tr><td colspan="2">Energy transfer and systems</td><td>Energy and development in South Africa</td></tr>
<tr><td colspan="2">▪ Electricity (Electrical energy)
Static electricity
Current electricity
- Charge
Electric current
Current convention, The coulomb, The use of the Ammeter, Potential difference, Resistance and how to measure, resistance, Factors which determine the resistance of metallic conductors, Series and parallel connectors of cells and resistors, Circuits and circuits diagrams, Household wiring and a model of a household wiring
▪ Cost of electricity
▪ Safety measures</td><td>▪ Supply of electrical energy from power plants to households (discuss also energy supply and usage in rural areas, e. g usage of wood, etc)
▪ How electrical energy is generated</td></tr>
<tr><td colspan="3">PLANET EARTH AND BEYOND</td></tr>
<tr><td>Our place in space</td><td>Atmosphere and weather</td><td>The changing earth</td></tr>
<tr><td>▪ The sun is the major source of energy for phenomena on the earth's surface such as the water cycle</td><td>▪ Climate varies in different parts of the globe (emphasis should be on the adaptation of plants and animals to living in different climate regions). Link with Life and Living</td><td>▪ Mining and Minerals</td></tr>
<tr><td colspan="3">MATTER AND MATERIALS</td></tr>
<tr><td>Properties and uses of material</td><td colspan="2">Structure reaction and change material</td></tr>
<tr><td>▪ Matter
Properties of the different phases of matter in terms of
- Divisibility of matter
- Mixing and diffusion of gases and liquids
- Compressibility, crystalline structures
- Brownian Motion
- Forces between the particle</td><td colspan="2">▪ The particle model of the three phases of matter
▪ Chemical change of substances
- Atoms and molecules
Elements and compounds
Periodic table
Symbols and formulas
Chemical equations
- Combustion: What is combustion?
Combustion as reaction with oxygen: Investigate the combustion of Hydrogen; Carbon, Sulphur, Magnesium and Iron in Oxygen. Represent the reactions with chemical equations.
- Heating of substances
Decomposition of substances by heating. Investigate the heating of copper carbonate, mercury oxide and ammonium carbonate. Show chemical equation to represent the reactions
▪ Reaction of Acids with:
- Metals, Oxides, Carbonates, Alkali (Bases)</td></tr>
</table>

APPENDIX M

2008 Grade 12 Physical Science results per province (DoE, 2009),



	EC	FS	GP	KZN	LP	MP	NW	NC	WC	NAT
≥30%	43.	63.	64.	49.	51.	47.	63.	62.	71.	54.
≥40%	20.	32.	37.	25.	23.	23	31.	32.	46.	28.

APPENDIX N

The composition and pass requirements of the National Senior Certificate (DoE, 2009).

NATIONAL SENIOR CERTIFICATE (NSC)

Three-year programme (Grades 10 – 12)

All candidates must offer seven subjects:

- ✓ Two Languages (Home Language Compulsory);
- ✓ Math/Math Literacy;
- ✓ Life Orientation and;

- ✓ Three choice subjects

The National Senior Certificate requires minimum of three subjects achieved (passed) at 40% and three subjects at 30%.

25% of mark is school-based assessment and 75% from external examination.

APPENDIX O

CLASS OF 2008 (DoE, 2009)

- ✓ In Grades 3 – 9 offered Curriculum 2005 and in Grades 10 – 12 (2006 to 2008) NCS
- ✓ Record number of learners: 150 000 more than in 2003 and 28 000 more than in 2007
- ✓ No repeaters or part-time learners
- ✓ More female than male candidates

Categories of achievements	Number of candidates	Percentage	Achievement requirements
Achieved – Bachelors (University admission)	107 462	20.2%	NSC and a minimum of 30% in the LOLT of the higher education institution coupled with an achievement rating of 4 (50-59%) or better in four subjects from the designated list
Achieved – Diploma (Admissions for Technikon)	124 395	23.3%	NSC and a minimum of 30% in the LOLT of the higher education institution coupled with an achievement rating of 3 (40-49%) or better in four recognised NSC subjects
Achieved - Higher Certificate (Ordinary pass)	102310	19.2%	NSC and a minimum of 30% in the *LOLT of the higher education institution
Did not achieve	60 000	11.25%	
Number qualified for supplementary	142000	26%	
Total	533 561		

*LOLT – Language of learning and teaching