

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52		
1	1	2	3	3	7	7	99	99	2	2	0	1	0	1	99	99	99	99	99	1	1	0	2	2	3	0	1	0	0	1	0	0	0	1	1	1	1	0	3	2	2	0	0	2	0	2	2	2	0	0	99	99	
1	2	1	2	3	3	1	99	99	2	0	0	0	0	0	0	0	1	1	1	5	1	0	1	1	0	0	1	0	0	1	0	0	1	0	0	1	0	2	0	0	2	2	1	1	0	0	0	0	1	1			
1	3	5	1	1	3	3	99	99	2	2	0	1	1	1	99	99	99	99	99	7	0	0	1	1	0	0	1	0	0	1	2	3	0	1	1	1	0	3	1	2	3	1	0	2	2	1	0	0	99	99			
2	1	4	2	4	8	8	99	99	1	1	1	1	0	1	99	99	99	99	99	2	2	0	2	2	3	0	1	3	1	1	2	3	2	2	0	2	1	1	0	2	1	1	2	3	2	2	2	0	1	99	99		
2	2	5	3	0	1	1	99	99	1	0	0	0	0	0	0	0	3	1	0	12	1	0	2	2	3	0	1	1	2	2	3	3	0	0	1	1	2	0	5	1	1	2	3	2	2	0	2	2	1	1			
2	3	12	1	3	5	5	99	99	2	2	0	1	1	1	99	99	99	99	99	4	3	1	2	2	0	0	2	0	1	1	3	3	2	1	1	0	3	2	2	1	2	2	0	1	1	0	0	99	99				
3	1	11	1	2	5	5	99	99	0	1	0	0	0	0	99	99	99	99	99	5	2	0	1	1	3	0	1	0	0	0	0	1	2	1	0	0	1	0	1	0	0	2	3	0	1	1	0	0	99	99			
3	2	13	3	0	1	0	1	0	2	0	0	0	0	0	0	0	1	1	0	7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1			
3	3	7	2	0	1	0	99	99	0	0	0	0	0	0	0	99	99	99	99	11	1	0	2	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	2	1	0	0	0	0	99	99		
4	1	10	2	4	8	8	99	99	2	2	1	1	0	1	99	99	99	99	99	1	0	2	2	1	3	0	1	0	0	1	0	0	1	2	1	1	1	1	0	1	0	1	2	0	2	2	3	0	0	99	99		
4	2	7	1	2	5	5	99	99	0	1	0	0	1	1	0	0	7	6	1	2	2	0	2	2	3	0	1	2	1	1	0	0	1	2	0	2	1	2	2	0	1	2	3	2	2	1	4	3	3	6			
4	3	2	3	1	4	4	99	99	1	1	1	1	1	1	1	99	99	99	99	5	1	1	2	1	0	0	2	0	1	1	0	0	1	1	1	1	1	0	3	1	1	2	4	2	1	1	0	0	99	99			
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6	2	5	1	1	1	1	99	99	2	1	0	0	0	1	0	0	2	1	0	11	1	0	1	1	2	0	1	2	0	1	1	2	1	0	0	1	0	1	0	2	0	1	2	2	2	1	2	2	1	1			
6	3	11	2	2	3	3	99	99	2	1	0	0	0	0	99	99	99	99	99	2	2	1	2	1	4	1	1	2	3	2	2	0	2	0	3	2	4	1	1	2	3	2	2	2	1	2	99	99					
7	1	11	3	0	3	7	99	99	0	2	1	1	1	1	1	99	99	99	99	5	1	0	0	1	0	0	1	0	0	1	1	2	1	2	0	1	0	1	0	2	0	0	2	0	0	2	3	0	0	99	99		
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7	3	8	2	2	2	2	5	3	2	2	1	1	1	1	1	99	99	99	99	11	1	1	2	1	0	0	1	0	0	1	1	1	1	1	0	4	3	3	1	1	2	3	2	2	1	0	0	99	99				
8	1	8	1	2	4	4	5	5	0	2	0	0	0	0	99	99	99	99	11	1	0	2	1	0	0	1	0	0	1	2	1	0	1	1	0	1	1	1	0	1	2	3	2	2	2	0	0	99	99				
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9	2	5	2	1	1	0	99	99	0	0	0	0	0	0	0	0	1	1	2	1	0	0	0	3	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	2	1	2	2	0	1	0	1	1					
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10	2	8	3	3	3	3	3	3	2	1	0	0	0	0	0	4	1	1	1	1	1	1	3	1	1	1	0	1	1	2	1	2	0	0	0	0	2	0	1	1	1	2	3	2	2	0	4	4	1				
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11	1	7	2	3	7	7	99	99	1	2	0	1	0	1	99	99	99	99	2	2	0	2	2	3	0	1	3	0	1	2	3	2	2	0	2	1	1	0	5	0	1	2	3	2	2	0	3	99	99				
11	2	2	3	5	5	1	99	99	0	0	0	0	1	0	0	0	1	1	1	5	0	1	0	1	0	0	1	0	0	1	1	1	0	0	1	1	1	0	0	0	0	2	0	0	0	0	0	1	1				
11	3	5	1	3	5	4	99	99	2	2	1	1	0	1	99	99	99	99	7	2	1	1	1	0	0	3	0	0	1	1	2	2	0	1	0	1	1	2	2	0	1	0	1	2	2	3	2	0	0	99	99		
12	1	9	1	3	7	7	99	99	0	2	0	1	0	1	99	99	99	99	2	3	0	2	1	0	0	1	1	1	1	2	3	1	2	0	1	0	2	0	3	0	1	2	2	2	1	0	0	99	99				
12	2	4	3	1	1	0	99	99	0	0	0	0	0	0	0	0	2	1	1	11	1	2	1	0	0	0	1	0	0	1	2	2	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	1			
12	3	1	2	2	2	2	99	99	2	0	0	0	0	0	0	99	99	99	99	5	0	1	2	0	0	0	1	0	1	1	2	2	2	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	99	99			
13	1	2	1	2	6	6	6	6	1	1	0	1	0	1	99	99	99	99	11	1	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	2	1	0	1	99	99
13	2	9	2	0	1	1	99	99	1	0	0	0	0	0	0	0	1	0	0	5	1	0	0	0																													

27	3	5	1	3	3	3	99	99	2	2	0	0	0	0	0	99	99	99	99	99	8	2	2	2	1	0	0	1	1	0	1	2	2	0	0	0	0	0	1	0	4	0	0	2	1	0	2	0	0	1	99	99			
28	1	2	1	5	8	8	99	99	1	2	0	1	1	1	1	99	99	99	99	99	5	1	1	1	2	0	0	2	0	0	1	1	2	1	1	1	1	1	1	3	2	1	1	2	1	2	2	3	0	0	99	99			
28	2	5	2	5	5	5	99	99	2	1	2	2	0	1	0	1	7	6	1	2	2	0	2	1	0	0	1	3	0	1	2	3	2	2	0	2	0	4	1	5	0	1	2	3	2	2	1	4	4	6	5				
28	3	7	3	4	4	4	99	99	2	2	0	0	0	0	99	99	99	99	99	1	2	1	2	1	0	1	1	0	0	1	2	2	2	1	0	1	0	2	3	3	1	1	1	2	2	1	1	1	0	99	99				
29	1	5	1	5	5	5	5	5	0	0	0	0	0	0	0	99	99	99	99	99	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	99	99			
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29	3	1	3	1	1	1	99	99	2	0	0	0	0	0	0	99	99	99	99	99	5	0	0	1	0	2	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	99	99		
31	1	8	2	2	3	3	3	3	1	0	0	0	0	0	0	99	99	99	99	99	5	1	0	2	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	1	0	1	1	0	2	1	1	1	0	0	0	99	99		
31	2	4	1	0	0	0	99	99	1	0	0	0	0	0	0	0	0	0	0	8	0	1	0	0	0	0	1	0	0	0	1	1	2	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0			
31	3	2	3	1	2	2	2	2	1	0	0	0	0	0	0	99	99	99	99	99	11	1	1	1	1	0	0	1	0	0	1	0	0	1	0	0	1	1	0	0	0	1	2	1	1	1	2	3	0	2	0	0	0	99	99
32	1	5	3	4	4	4	4	4	0	0	1	1	0	0	99	99	99	99	99	2	1	0	2	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	2	0	0	0	0	0	1	2	3	2	2	1	0	0	99	99	
32	2	2	2	5	5	5	5	5	2	1	1	1	0	1	0	1	7	6	1	11	1	1	1	1	2	0	1	3	0	1	1	0	2	2	0	1	0	2	0	2	0	1	2	3	2	2	1	3	3	2	1				
32	3	11	1	1	6	6	99	99	2	2	0	1	0	1	99	99	99	99	99	5	1	1	2	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	3	1	1	2	1	0	0	2	0	0	99	99			
30	1	10	1	2	4	4	99	99	0	0	0	0	0	0	0	99	99	99	99	12	1	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	99		
30	2	12	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
30	3	10	2	1	1	1	1	1	0	0	0	0	0	0	99	99	99	99	99	2	1	0	1	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	99	99	

Association for the Cooperative Advancement of Science and Education
APPENDIX H

KEY TO COLUMN NUMBERS FOR DATA MATRIX

COLUMN NUMBER	MEANING	VALUE RANGE
1	:Student Identification Number	:1-32
2	:Task Identification Number	:1 = BAL :2 = FLO :3 = PEN
3	:Scorer Identification Number (For LOC)	:1-13
4	:Order In Which Task Was Performed	:1 = First :2 = Second :3 = Third
5	:Initial Level Of Conceptualization	:1-9
6	:Nondirected Level Of Conceptualization (Stated)	:1-9
7	:Nondirected Level Of Conceptualization (Confirmed)	:1-9
8	:Directed Stated Level Of Conceptualization	:1-9
9	:Directed Confirmed Level Of Conceptualization	:1-9
10	:RK# 1 Measurement of weight (BAL) :RK# 1 Measurement of weight (FLO) :RK# 1 Measurement of time (PEN)	:0-2 :0-2 :0-2
11	:RK# 2 Measurement of distance (BAL) :RK# 2 Volume -- Nominal knowledge (FLO) :RK# 2 Measurement of distance (PEN)	:0-2 :0-1 :0-2
12	:RK# 3 Knowledge of ratio -- Nominal (BAL) :RK# 3 Measurement of Volume -- Solid (FLO) :RK# 3 Knowledge of ratio -- Nominal (PEN)	:0-1 :0-2 :0-1
13	:RK# 4 Knowledge of ratio -- Functional (BAL) :RK# 4 Measurement of volume -- Liquid (FLO) :RK# 4 Knowledge of ratio -- Functional (PEN)	:0-1 :0-2 :0-1
14	:RK# 5 Knowledge of proportion -- Nominal (BAL) :RK# 5 Knowledge of ratio -- Nominal (FLO) :RK# 5 Knowledge of proportion -- Nominal (PEN)	:0-1 :0-1 :0-1
15	:RK# 6 Knowledge of proportion -- Functional (BAL) :RK# 6 Knowledge of ratio -- Functional (FLO) :RK# 6 Knowledge of proportion -- Functional (PEN)	:0-1 :0-1 :0-1
16	:RK# 7 Knowledge of proportions -- Nominal (FLO Only)	:0-1
17	:RK# 8 Knowledge of proportions -- Functional (FLO Only)	:0-1
18	:RK# 9 Density of the object (FLO Only)	:0-7
19	:RK#10 Density of the liquid (FLO Only)	:0-6
20	:RK#11 Knowledge of density -- Nominal (FLO Only)	:0-1
21	:Scorer Identification Number (For STC)	:1-13
22	:STC# 1 Uses covariation as a basis for inferring causality	:0-4
23	:STC# 2 Uses absence of covariation as evidence of no relationship	:0-2
24	:STC# 3 Varies factors to establish the presence or nature of a relationship	:0-2
25	:STC# 4 Coordinates theory with evidence	:0-2
26	:STC# 5 Generates and uses analogies in conceptualizing phenomena	:0-4
27	:STC# 6 Applies physical intuition	:0-2
28	:STC# 7 Identifies potential causal factors and generates variables to represent factors	:0-2
29	:STC# 8 Formulates composite variables	:0-3
30	:STC# 9 Reasoning concerning extreme cases	:0-2

APPENDIX H

31	:STC#10 Goal oriented observations	:0-2
32	:STC#11 Records observations	:0-2
33	:STC#12 Consults recorded notes	:0-3
34	:STC#13 Innovation concerning task materials	:0-Open Ended
35	:STC#14 Searches for a necessary underlying principle	:0-3
36	:STC#15 Searches for parsimony	:0-2
37	:STC#16 Internally consistent in explanation	:0-3
38	:STC#17 Concerned for accuracy of language	:0-2
39	:STC#18 Concerned with precision of measurement	:0-4
40	:STC#19 Identifies sources of error in taking measurements	:0-3
41	:STC#20 Uses techniques for precise measurement	:0-5
42	:STC#21 Reaction to disconfirmation	:0-3
43	:STC#22 Concerned for verification	:0-2
44	:STC#23 Considers relative value of empirical evidence	:0-2
45	:STC#24 Controls variables	:0-4
46	:STC#25 Makes unsolicited predictions	:0-3
47	:STC#26 Uses predictions to test hypotheses	:0-3
48	:STC#27 Uses Proportional Reasoning	:0-3
49	:STC#28 Classification	:0-4
50	:STC#29 Seriation	:0-4
51	:Initial Score For RK# 9	:0-7
52	:Initial Score For RK#10	:0-6

NOTES: Meanings of abbreviations:

- LOC: Levels Of Conceptualization
- STC: Scientific Thinking Characteristics
- RK : Related Knowledge
- BAL: Task 1 - Equilibrium on the Balance Beam
- FLO: Task 2 - Floating and Sinking
- PEN: Task 3 - Period of the Pendulum

- A value of 99 has several possibilities
- > 99 appears in columns 10-15 and columns 53 & 54 for PEN or BAL since data elements do not exist in these ranges for these tasks.
 - > 99 appears in columns 8 & 9, if the student never reached the stage of directed enquiry.
 - > 99 appears in other areas only when a score is not available for that element.