



Pointing Exercise

Background

Normal activity on Earth such as walking, standing, sitting, and working with the hands requires the brain to interpret and integrate information from all the body's senses (touch, hearing, sight, etc.). Once the brain processes this information, it gives feedback to the body on how limbs are positioned, how the entire body is oriented (up or down, right or left), and which muscles should be moved to re-orient the body.

In the free-fall environment of space, the inner ears, muscles, joints, and skin cannot rely on gravity as a constant indicator of position and orientation. In order to produce correct responses, the brain must rearrange the relationships among the signals from these sensory systems when it processes the information. This rearrangement requires a period of adaptation. Before the body adapts, astronauts can get the illusion that their body or their environment is moving when both are stationary. When they return to Earth they may experience these problems again, since their body must readjust to the sensation of gravity. The length of recovery time is related to the duration of the mission.

Class Discussion

- Ask students to describe their experiences on roller coasters and/or their experiences on "virtual roller coasters."
- When you are in free fall things appear to have no weight because they are falling at the same rate as you are.

This activity helps students understand the adaptations that astronauts must undergo in their microgravity environment.

Pointing Exercise

Purpose:

To observe how their ability to point at a familiar object is compromised in a simulated 2g environment (double gravity) and how their pointing ability adapts back from a 2g environment to a 1g environment (normal gravity).

Materials:

Each group needs:

- Pointing Exercise Target Board
- Pointing Exercise Record Sheet
- markers
- 2g Simulator*
- stopwatch or timer
- elastic bands (or tape)

***How to make a 2g Simulator**

1. Fill a self-seal bag with 2-3 kg of damp sand.
2. Seal the bag removing as much air as possible.
3. Spread the sand equally throughout the bag.

Commercial wrist or ankle weights can also be used for the mass apparatus.

What To Do

1. Form groups of 4 students. Within each group, select a student to read out the numbers (Prompter). Other team members will act as The Timer, The Recorder, and The Pointer.
2. Read the directions together and answer questions they may have.
3. Encourage students to point as quickly as possible as this is a timed event.

The Exercise

Timing begins when The Prompter gives the first of the series of numbers and ends when The Pointer's hand returns to the starting position after the last number is touched.

The Recorder keeps track of the numbers that were actually touched when each number was called.

At the starting position, The Pointer holds the forearm parallel to the floor with the elbow alongside the body.



The Prompter calls out a series of numbers stopping after each one until The Pointer touches the Target Board and returns his/her arm to the starting position.

TRIAL 1

125, 82, 142, 65, 113, 96, 172, 143, 160, 72.

Repeat this activity with the 2g Simulator secured to the forearm of The Pointer. Use the elastic bands to secure the 2g Simulator.

TRIAL 2

65, 143, 113, 82, 160, 125, 172, 142, 96, 72.

Remove the 2g Simulator and IMMEDIATELY repeat the activity.

TRIAL 3

72, 113, 160, 96, 125, 65, 143, 82, 142, 172.

Working in their groups, ask the students to analyze the record sheet and to prepare conclusions.

Class Discussion

1. What effect did adding and removing the mass on your arm have on your pointing accuracy?
2. Were the results of Trial 3 the same as Trial 1? Why or why not?
3. Relate the adaptations that you experienced to those faced by astronauts in microgravity on the space shuttle or the space station.

Target Board

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	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195
196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225

POINTING EXERCISE RECORD SHEET

The group recorder fills in the chart to track the numbers that the pointer touched in each trial.

Trial # 1 - Without the 2 g Simulator

Numbers Called	Numbers Pointed to
125	
82	
142	
65	
113	
96	
172	
143	
160	
72	

Trial # 2 - With the 2 g Simulator

Numbers Called	Numbers Pointed to
65	
143	
113	
82	
160	
125	
172	
142	
96	
72	

Trial # 3 - Without the 2 g Simulator

Numbers Called	Numbers Pointed to
72	
113	
160	
96	
125	
65	
143	
82	
142	
172	