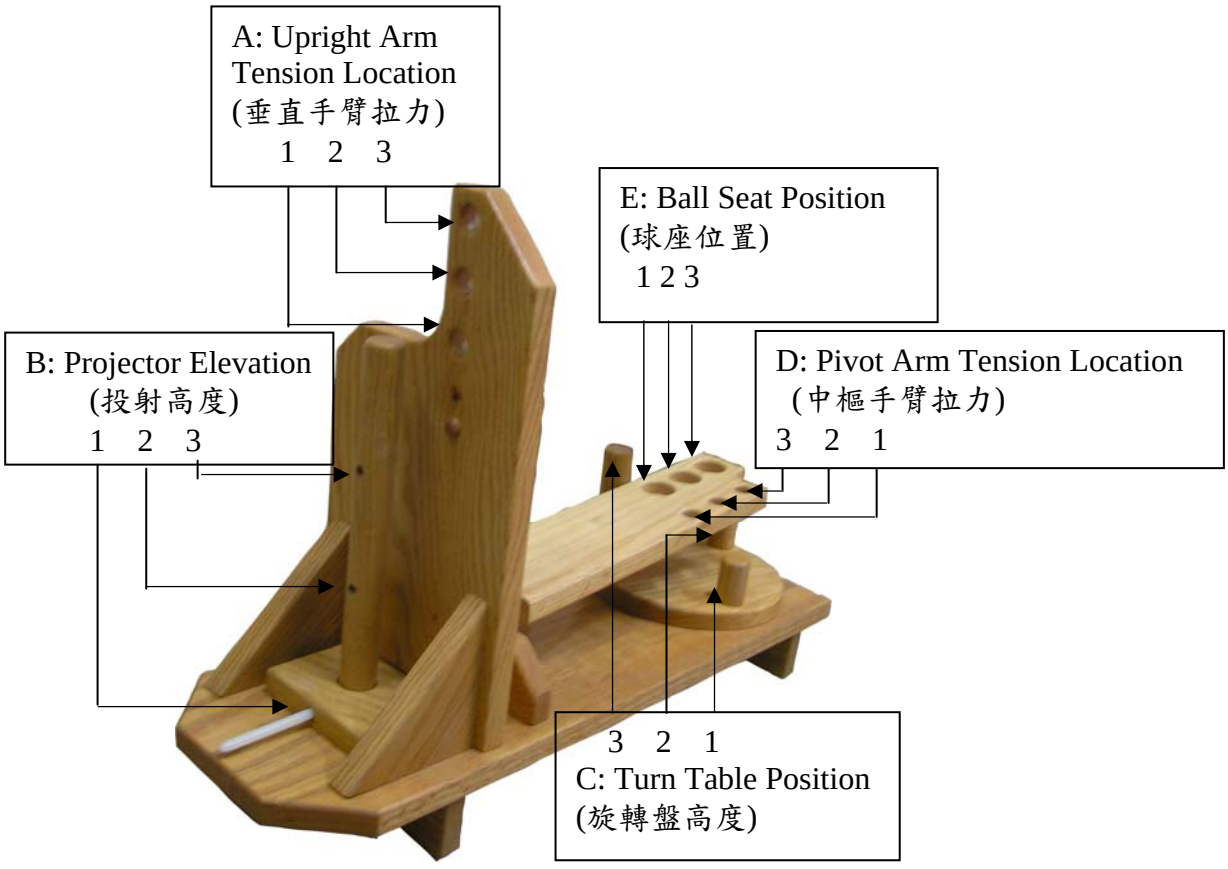
CAT-100 Catapult Demonstration

The CAT-100 catapult has six different factors, each of which can be set at three different levels. They are:

Factor (因子)	Factor Name (因子名稱)	Level (水準)
A	A: Upright Arm Tension Location (垂直手臂拉力)	1: Low level, 2: Medium level, 3: High level (1:低水準、2:中水準、3:高水準)
B	B: Projector Elevation (投射高度)	1: Low level, 2: Medium level, 3: High level (1:低水準、2:中水準、3:高水準)
C	C: Turn Table Position (旋轉盤高度)	1: Low level, 2: Medium level, 3: High level (1:低水準、2:中水準、3:高水準)
D	D: Pivot Arm Tension Location (中樞手臂拉力)	1: Low level, 2: Medium level, 3: High level (1:低水準、2:中水準、3:高水準)
E	E: Ball Seat Position (球座位置)	1: Low level, 2: Medium level, 3: High level (1:低水準、2:中水準、3:高水準)
F	F: Ball Type (球種類)	1:Foam(yellow), 2:Whiffle(white), 3:PingPong(orange) (1:黃色球、2:白色球、3:橘色球)



To test each factor at each level would require a full factorial experiment consisting of 729 different treatment combinations ($3^6 = 729$). If the experiment is conducted only using the Level I and II the experiment is reduced to $2^6 = 64$ treatment combinations. This is still a large experiment, hence the need to develop some sort of fractional experiment or Taguchi orthogonal array. (from http://www.qualitytng.com/shop/?page=shop/catdemo)

Different types of fractional factorials can be developed based on the instructor's preferences. The following example is for a one-eighth (2^{6-3}) fractional factorial with two replications of each treatment. The response variable is the distance the ball is thrown in inches.

Run Order	A	B	C	D	E	F	Response
	Upright Arm Tension Location	**Projector Elevation**	**Turn Table**	**Pivot Arm**	**Ball Seat**	**Ball Type**	**Distance**
1	1	1	2	2	1	1	
2	2	1	2	1	2	1	
3	1	1	1	2	2	2	
4	1	2	2	1	1	2	
5	1	2	1	1	2	1	
6	1	2	1	1	2	1	
7	1	1	1	2	2	2	
8	2	1	1	1	1	2	
9	2	2	2	2	2	2	
10	2	2	1	2	1	1	
11	2	2	2	2	2	2	
12	2	1	2	1	2	1	
13	1	1	2	2	1	1	
14	2	2	1	2	1	1	
15	1	2	2	1	1	2	
16	2	1	1	1	1	2	

Other Designs

Full Factorial Design	Factors	Level	Replicates	Runs
2^3	3 (A, D, C)	2	2	16
2^4	4 (A, D, E, C)	2	1	16
2^4	4 (A, D, E, C)	2	2	32

Fractional Factorial Design	Factors	Level	Replicates	Runs
2^{6-3} (1/8 fraction)	6 (A, B, C, D, E, F)	2	2	16
2^{6-2} (1/4 fraction)	6 (A, B, C, D, E, F)	2	2	32
2^{5-1} (1/2 fraction)	5 (A, B, C, D, E)	2	2	32