

Student Activity: Parametric Throw

Overview: The height of a bouncing ball over time can be modeled parametrically.

Objective: **Mathematical Models with Applications TEKS:**
1B, 3A, 3C, 8B

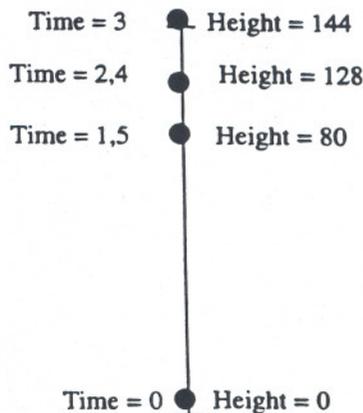
Terms: Parametric equation

Materials: Graphing calculator, data collection device, motion detector, and bouncy ball

Procedures: Bounce the ball a few times and ask students to recall the motion detector graph of the height of the ball versus time. Students should recall the position equation $h(x) = 96x - 16x^2$, where x is the time in seconds and h is the height of an object thrown straight up at 96 ft/sec. Have students graph $y = 96x - 16x^2$ in a suitable viewing window and then use trace or the table feature to fill in the chart. Then they should locate the position of the object on the vertical number line at each time as shown below.

1.

Time (sec.)	Height (feet)
0	0
1	80
2	128
3	144
4	128
5	80
6	0



2. What does t represent? [time]
3. What does x represent? [track]
4. What does y represent? [height of object]
5. The parametric equations follow:

```

Plot1 Plot2 Plot3
X1T=3
Y1T=96T-16T^2
X2T=
Y2T=
X3T=
Y3T=
X4T=
    
```

6. Possible window settings follow:

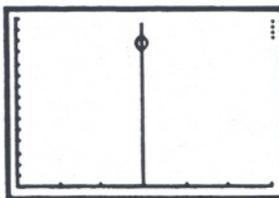
```

WINDOW
Tmin=0
Tmax=6
Tstep=.1
Xmin=0
Xmax=6
Xscl=1
Ymin=0
    
```

```

WINDOW
↑Tstep=.1
Xmin=0
Xmax=6
Xscl=1
Ymin=0
Ymax=150
Yscl=10
    
```

7. Trace over the graph to identify points and note the speed determined by the vertical distance between points. That is, the further apart per time interval, the faster the speed.



Extension: Try this graph. Why does it work?



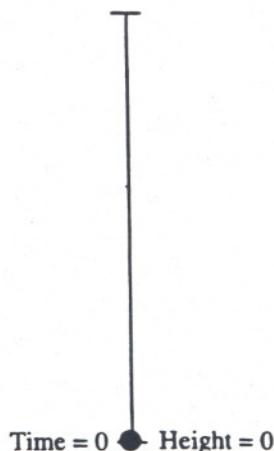
Summary: Parametric graphing enables us to simulate the real-world phenomenon of throwing an object up.

Parametric Throw

Recall the position equation $h(x) = 96x - 16x^2$, where x is the time in seconds and h is the height of an object thrown straight up at 96 ft/sec.

- Graph $y = 96x - 16x^2$ in a suitable viewing window. Using the trace or table feature, fill in the following chart. Then locate the position of the object on the vertical number line at each time.

Time (sec.)	Height (feet)
0	
1	
2	
3	
4	
5	
6	



How would you model the ball throw parametrically?

- What does t represent?
- What does x represent?
- What does y represent?
- Write your parametric equations: $x_{1T} =$
 $y_{1T} =$
- Write your window settings.

- Sketch the graph. Label your axes including units.

