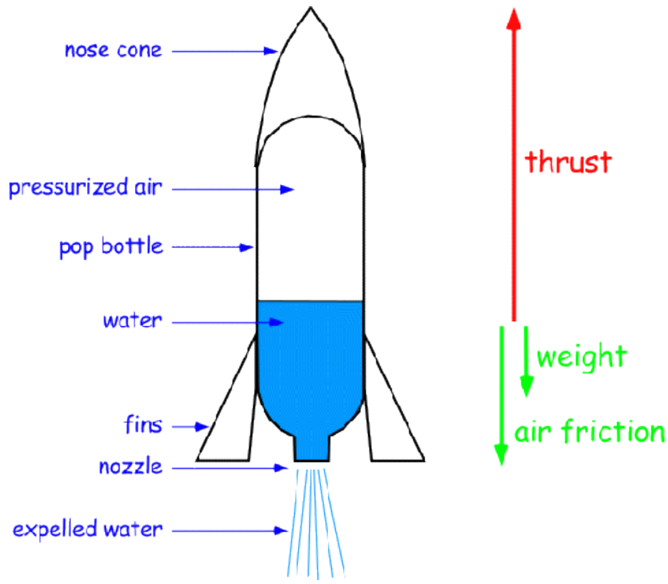
2-Liter Water Bottle Rockets Overview

Great detailed website: http://www.et.byu.edu/~wheeler/benchtop/flight.php



The equation for thrust, caused by water exiting the nozzle, is:

$$T = (P_{in} - P_{out}) \cdot A_n$$

where P_{in}-P_{out} is the difference between pressure within the rocket and atmospheric pressure, and A_n is the cross-sectional area of the nozzle opening. Thrust is dependent on pressure, nozzle diameter. The amount of water dictates how long the thrust force will be applied, and therefore contribute to the rocket's total kinetic energy.

Motor Impulse Classes	
Impulse /Ns	Class
I <= 0.625	¼A
0.625 < I <= 1.25	½A
1.25 < I <= 2.5	A
2.5 < I <= 5	B
5 < I <= 10	C
10 < I <= 20	D
20 < I <= 40	E
40 < I <= 80	F
80 < I <= 160	G
160 < I <= 320	H
320 < I <= 640	I
640 < I <= 1280	J
1280 < I <= 2560	K
2560 < I <= 5120	L
5120 < I	>L

The following values are the optimal values for maximum height at 90 psi:

- Air/Water ratio = 0.5 liters
- Dry Weight = 220 grams
- Stabilizer Length = 3.5 inches
- Maximum Height = 350 ft (impact pressure = 120 mph baseball pitch)

Water Bottles with thicker plastic (cord strength) can be pressurized greater; many European bottles have much stronger cord strengths than U.S. plastic bottles.

The following mathematical expression yields ~apogee height for a given total flight time:

$$h_{ap} = (g/8)(t_{end})2 - 3.5 \text{ meters}$$

Water rockets, requiring a largish capacity for air and water, are usually large in diameter, this causing a large amount of drag and limiting the height achieved. However, the impulse rating for even a 2 liter water rocket is normally E - four times the impulse of a pyro motor that can be bought over the counter in a high street toy shop.