

***Comparison Of The Number Of Parachutes Versus
Descent Rate***

***NARAM-52 R&D Project
July 2010***

***By Allison Van Milligan
NAR # 88840
A-Division***

Summary

In this Project I compared the number of parachutes vs. descent rate. I compared one parachute vs. two parachutes vs. three parachutes. I kept the area the same, the shape the same, the distance between the canopy and the payloader the same, and the over all weight the same. The only difference was the number of parachutes. I kept the area the same by making the parachute canopies small in the clusters.

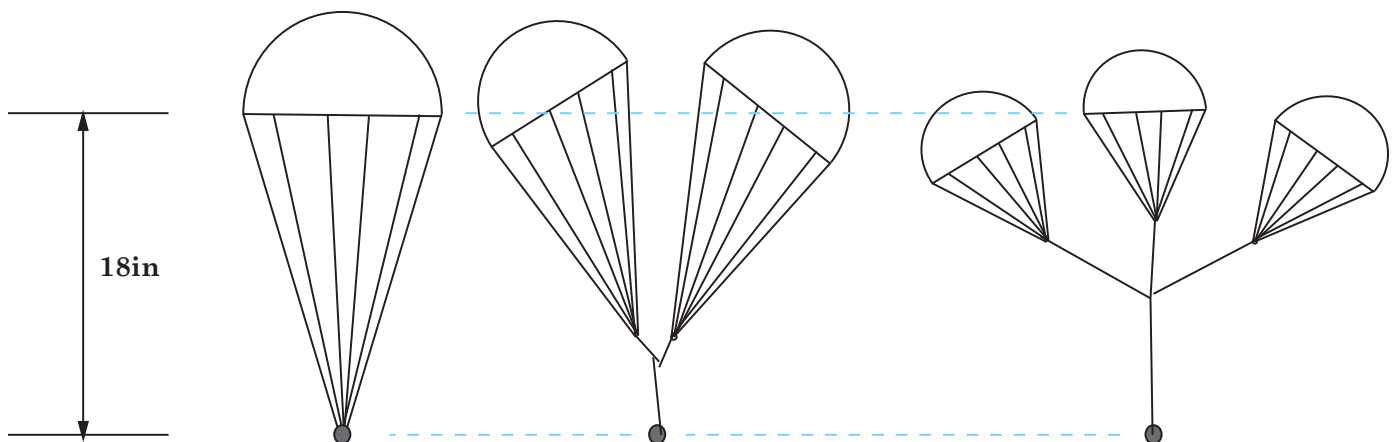
First, I launched the rocket with one of each cluster in it. I measured the altitude using an altimeter and the descent time using a stopwatch.

I used Quest's rocket called Big Dog. I launched it nine times. And in those tests the cluster of two worked best with the longest descent times.

Then I decided to do drop tests. I looked everywhere for a high place. I found a great place but it had a fence so I could not do it. I decided to do it off the roof of my house. In that test the cluster of two parachutes also worked the best by coming down the slowest.

My results are the cluster of two parachutes worked great in both test by coming down slowest. The single parachute worked second best. The cluster of three parachutes worked fine, but they got knotted really easy.

I probably would not use not use the cluster of three parachutes because it might be to fat to fit in the rocket and it is heavier so it would come down faster than what you'd want for parachute duration.

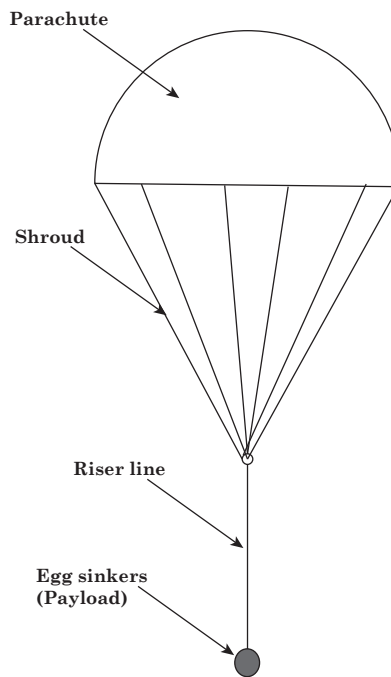


The objectives of the work

I am trying to find out how the number of parachutes effect how slow the rocket falls.

I will test one vs. a cluster of two vs. a cluster of 3 parachutes to see which type works best and slowest.

I made the parachutes to all equal the same area. Then I tied the clusters to weights, put them in a rocket and flew it. When the parachutes came out we timed it. I also the found hight of the rocket using an altimeter. I did this so I could find the speed of the falling parachutes.

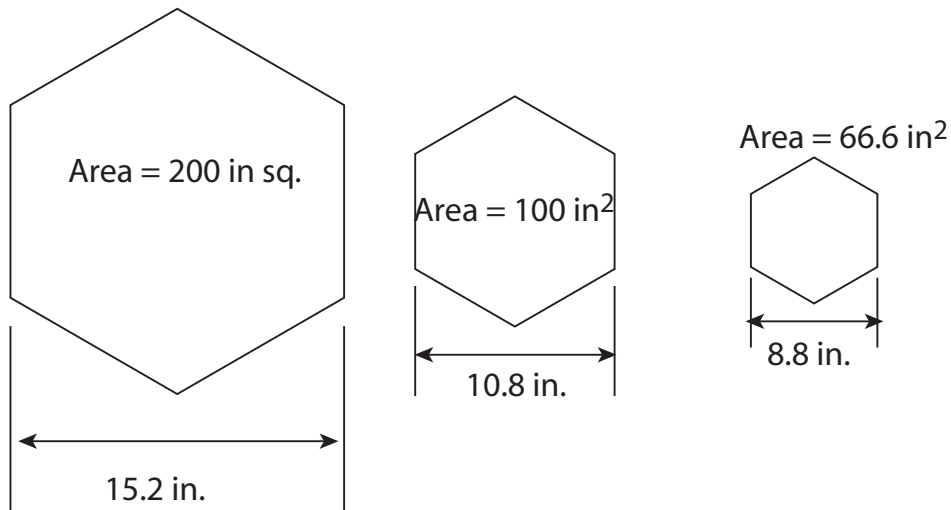


Drawling 1: Parts of my parachute

The approach taken

Step 1: I figured out what size to make the parachutes. The first parachute that we tried was 500 in^2 (24 inch diameter) and it was too big. We tried this parchute because my dad already had one this size. We fond out it were too big.

Step 2: I thought it was too big for the rocket. I decide to make the biggest one 200 in^2 . I went to <http://www.mathopenref.com/polygonregulararea.htm> to figure out how big to make the hexagons. The program is easy to use and it told me how big to make the hexagons. The biggest one will be 200 in^2 . The to shoot will be 100 in^2 . The three chute test will be 66.66 in^2 .



Drawing 2: Parachute Sizes

Step: 3 once I had the radius I put them in a drawing program and made a template. So I knew how big to make the parshutes. Then I printed the parshutes. They did not fit on one piece of paper so I had to tape them toghter on a window.

Step 4: I cut out the parachute shapes with a knife and ruler.

Step 5: Then I cut the parachutes out of trash bags, using a knife and ruler. Being careful not to move the trash bag around. I have 4 big ones, 8 medium size, and 16 little ones. I made extra just incase one breaks.



Photo 1: Cutting out parachutes.

Step 6: I put the strings on the big parachutes. Each string was 3ft. long. The strings on the medium parshuts were 24in long. On the little ones are 15 in long.

Step7: I tied the Snap swivel on the parachutes strings. The big one string was 18 in long, the medium won was 12 in long, and the small won was 8.8 in long. The distance was measure from the corns of the parachutes to the not on the snap swivel. This way all the

parachutes had the same length strings.

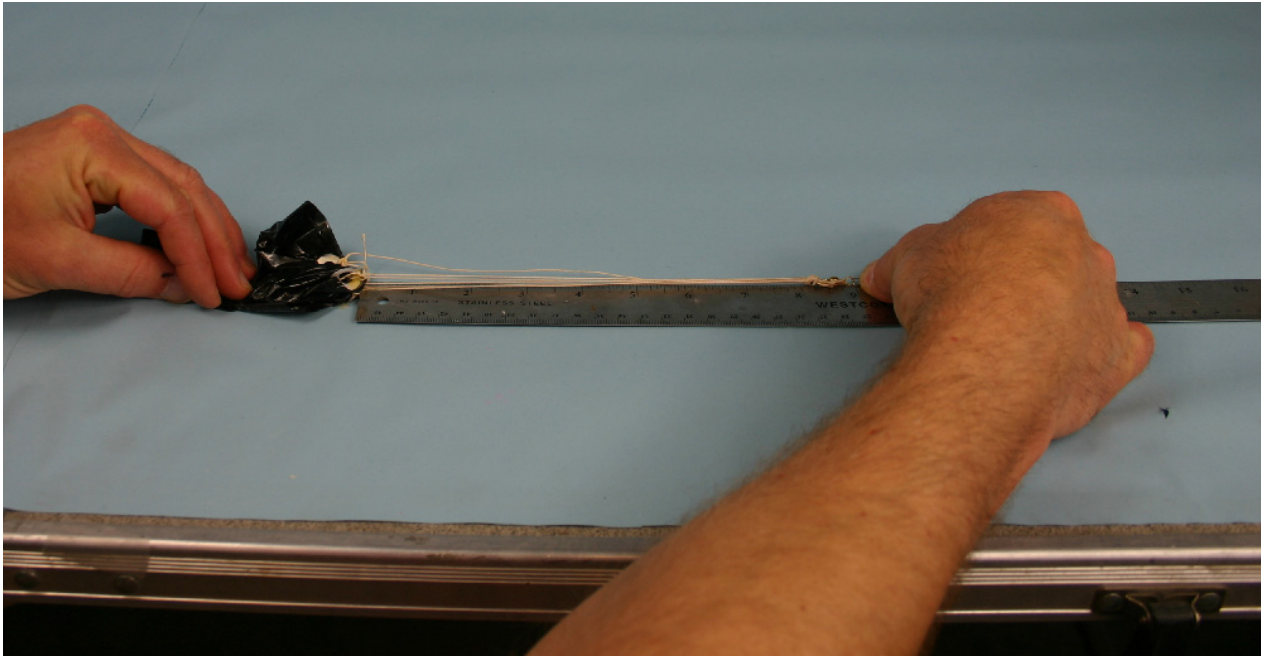
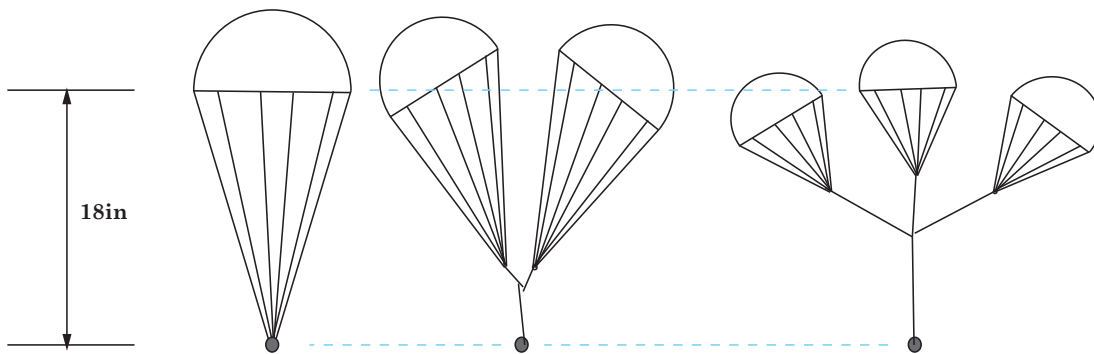


Photo 2.: Measuring Shroud Lines



Drawing 3: parachute types

Step 8: I put the egg snickers on a piece of Kevlar, and put two knots on it. This is I will attached the parachutes. These will be called my payload weights.

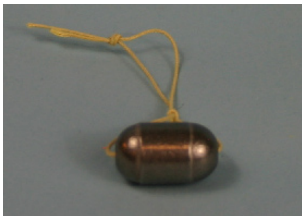


Photo 3: Egg Sinker used as payload Weight

Step 9: I put glue on all the strings but before I did, I double chued them. To let the

glue dry I put the on a hanging string. I have 19 parachutes now. 9 Small, 6 mediums, 4 big.



Photo 4: Parachutes on clothes line to let glue dry.

Step 10: I cut all the extra strings off.

Step 11: put a marker on the payload weights. So I could tell them a part. Then I weighted all the payloads and made a chart (see table 1).

Table 1: Payload Weights

Payload number	1	2	3	4	5	6	7	8	9
Weight	20.1g	20.4g	20.2g	20.6g	20.3g	20.3g	20.0g	20.5g	20.4g

Step 12: I put a number on all the parachute 's corners so I could tell them a part. Then I weighted each parachute.

Table 2: weights of big parachutes

Parachute Number	1	2	3	4
Weight	4.8g	4.9g	5.1g	5.3g

Table 3: weights of medium parachutes

Parachute number	1	2	3	4	5	6
Weight	2.8g	3.3g	2.9g	2.8g	2.8g	3.0g

Table 4: Weights of small parachutes

Parachute number	1	2	3	4	5	6	7	8	9	10
Weight	2.1g	2.4g	2.3g	2.0g	2.3g	2.3g	2.3g	2.4g	2.3g	2.5g

Step 13: I made the riser lines out of Kevlar, snap swivels, and barrel swivel. The lengths of the risers on the small save were 5in, and on the small the riser line was 10 in long. I did this so all the parachutes are the same length. From the corner of the parachutes to the snap swivel that hooks to the payloads Wight.

Step 14: I weighted the risers line on the scale and wrote them on a chart. See tables 5 – 6.

Table 5: weights of long risers for small parachutes

Riser number	1	2	3
Weight	2.1g	1.4g	2.0g

Table 6: weights of short risers for medium parachutes

Riser number	1	2	3
Weight	1.8g	1.3g	1.9

Step 15: I tied the egg sinkers to the riser line on the parachutes. I also put these numbers on the chart. I tried to make all the parachutes weight the same by choosing a heavy parachute with a light parachute.

Step 16: I wrote down all the weights and all the groups witch were the parachutes, riser lines, and the payload weights.

Table 7: Small parachute Groups

	Group 1	Group 2	Group 3
Chute Numbers	10, 4, 5	8, 1, 6	2,3, 7
Payload weight #	#4	#6	#3
Long riser #	#2	#1	#3
Final Wight	28.8g	29.3g	29.5g

Table 8: Medium parachute Groups

	Group 4	Group 5	Group 6
Chute Numbers	1,2	4, 6	3, 5
Payload weight #	#2	#1	#7
Short riser #	#4	#5	#6

Final Wight	28.4g	27.4g	27.6g
-------------	-------	-------	-------

Table 9: big parachute Groups

	Group 7	Group 8	Group 9
Chute Numbers	3	4	1
Payload weight #	#5	#8	#9
Final Wight	25.5g	25.7g	25.3g

Step 17: I weighted all the groups one lat time and wrote them down (see Table 10).

Step 18: Because all the groups were different weights I had to make them the same by adding tape, nuts, and screws to the lighter weight parachutes. I added it to the payload weight. This is the additional weight weight needed in table 10.

All the groups weighted 29.5 grams.

Table 10: Parachutes Final Weights

No. Chutes	Payload Number	Payload Weight	Payload Number	Payload Weight	Payload Number	Payload Weight
3	4	28.8g	6	29.3	3	29.5*
Additional Weight needed		.7g		.2g		0g
2	2	28.4g	1	27.4g	7	27.6g
Additional Weight needed		1.1g		2.1g		1.9g
1 parachute	5	25.5g	8	25.7g	9	25.3g
Additional Weight needed		4.0g		3.8g		4.2g

* This is the highest Weight all other weights will match this.

Launch day

On launch day we got data on witch parachute came down slowest by putting them all in a rocket at the same time and seeing witch one came down last. I picked three random parachute groups one from each size.

Then, I folded the parachute groups and put them in the rocket. The rocket I used was Quest Big Dog. I used a D12-3 for each flight. I flew it 9 times.

I used 2 altimeters attached to the bottom of the nose to find out how high they flew.



Photo 5: AltimeterOne Altimeter

I timed them with a stopwatch and my dad's help. My dad also took video so we could make sure the times were correct. The video was needed cause there were only 2 stopwatches and three parachutes coming down.

The data collected is in tables 11, 12, and 13 beginning on the next page.



Photo 6: Big dog rocket with chutes inside

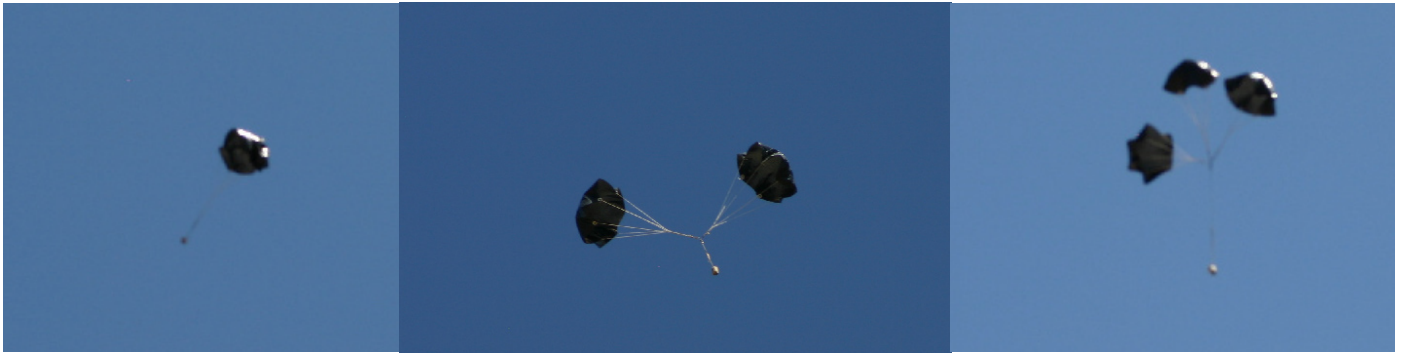


Photo 7: Parachutes in air

Table 11: launch data

Flight	1	2	3
Motor	D12-3	D12-3	D12-3
Wind	6.5 Knots	5.0knots	3.5knots
Temperate	72°f	74.2° f	77.5°f
Altitude 1	333ft	320ft	281ft
Altitude 2	361ft	333ft	300tf
Ave. Altitude	347ft	326.5ft	290.5ft
Pay loader group Big	9	9	9
Pay loader group Med.	7	7	7
Pay loader group Small	6	6	6
Time Pay loader group Big	23.03s	No Ejection	52.13s
Time pay loader group med.	27.65s	No Ejection	31.31s
Time payloader group small	27.65s	No Ejection	Hung in side tube- no deploy
Notes	I put the big in then the med in then the small on the top.	I put the small in then the big in then the med on the top.	#6 stayed on the rocket, #6 got melted.

Table :12 Launch Data

Flight	4	5	6
Motor	D12-3	D12-3	D12-3
Wind	1.5 Knots	.5 knots	.5knots
Temperure	80°f	84 ° f	87°f
Altitude 1	Altimeter broke	410ft	401ft
Altitude 2	509ft	383ft	370tf
Ave. Altitude	509ft	396.5ft	385.5 ft
Payloader group Big	9	8	8
Payloader group Med.	7	1	2
Payloader group Small	3	3	3
Time Payloader group Big	crash	25.48s	38.9s
Time payloader group med.	crash	41.4	No deploy
Time payloader group small	crash	42.51	No deploy
Notes	I put the big in then the small in then the med on the top. None came out. Altimeter broke.	I put the big in then the med in then the small on the top. #8 stuck together a little.	Big-top Medium-Middle Small-Bottom

Table: 13 Launch Data

Flight	7	8	9
Motor	D12-3	D12-3	D12-3
Wind	3.4 Knots	1.9 knots	2.7knots
Temperate	86°f	97 ° f	85°f
Altitude 1	344ft	388ft	372ft
Altitude 2	362ft	392ft	Forgot to write down
Ave. Altitude	353ft	390ft	372ft
Pay loader group Big	8	5	5
Pay loader group Med.	2	2	2
Pay loader group Small	4	4	4
Time Pay loader group Big	Hung on rocket	Hung on rocket	34.20s
Time pay loader group med.	34.7s	31.7	37.6
Time pay loader group small	Hung on rocket	Hung on rocket	One partially opened, then it fully opened. 35.72
Notes	I put the big in then the small in then the med on the top.	I put the big in then the small in then the med on the top.	Small-top Med-Middle Big-Bottom

Step: 18 some of the parachutes got melted. Four smalls number 7,6, 3, and 2. One medium, number 4. And two big numbers 4, and 3. When one parachute got melted I swapped the entire group so the weight always stayed 29.5 grams. This is why I made extra parachutes, in case some got melted.

Step 19. Finally I found the rate parachute groups. The rate of decent formula is altitude divided by the duration time. These are shown in Tables 14, 15, and 16.

Table 14: rate of descent for one parachute (actual launch data)

Flight number	Altitude	Duration	Rate of descent
1	347ft	23.03s	15.06 ft/s
3	290.5ft	52.13s	5.57 ft/s
5	396.5ft	25.48s	15.56 ft/s
6	385.5 ft	38.9s	9.91 ft/s
9	372ft	34.20s	10.8 ft/s
Average			11.3 ft/sec

Launch Data (Average Descent Times)	
1 Parachute	11.3 ft/sec
2 Parachutes	10.62 ft/sec
3 Parachutes	10.76 ft/sec
Drop Test Data (Average Descent Times)	
1 Parachute	8.54 ft/sec
2 Parachutes	8.15 ft/sec
3 Parachutes	9.13 ft/sec

Table 15: rate of descent for two parachutes (actual launches data)

Flight number	Altitude	Duration	Rate of descent
1	347ft	27.65s	12.55 ft/s
3	290.5ft	31.31s	9.28 ft/s
5	396.5ft	41.4	9.58 ft/s
7	353ft	34.7s	10.17 ft/s
8	390ft	31.7s	12.30 ft/s
9	372ft	37.6	9.89 ft/s
Average			10.62 ft/s

Table 16: rate of descent for three parachutes (actual launches data)

Flight number	Altitude	Duration	Rate of descent
1	347ft	27.65s	12.55 ft/s
5	396.5ft	42.51	9.33 ft/s
9	372ft	35.72	10.41 ft/s
Average			10.76 ft/s

Conclusions From Rocket Launches

My rocket launches went ok. The problem is getting the parachutes out of the rocket tube. If it did come out it opened just fine. The knot on the shoot cord was where they got stuck.

Some reasons I decided to do the drop test were, the motors were expensive, it was hot, and it took to long to prep the rockets for launch.

Drop tests

Because the rocket launch tests were not working great, such as the parachutes keep getting caught in the rocket, I decided to drop them off my house. So I could get a better rater of falling speed.

In order to do the drop test I had to make two new small parachutes to replace the ones that got melted. This way I had two of each cluster. In case one got stuck in a tree or something.

I made them just like the other ones in step six and seven.

Table 17: Weights of new small parachutes

Parachute number	11	12
Weight	2.3g	2.4g

Table 18: Small new parachute Group

	Group 10
Chute Numbers	11,12, 9
Payload weight #	#4
Long riser #	#3
Final Wight	29.4g

Table 19: Wight of big parachute

Parachute number	2
Weight	4.9

Table 20: big new parachutes Group

	Group 11
Chute Number	2
Payload weight #	#2
Final Wight	25.2g

First I measured the height from the dropping point on my house by putting an egg-sinker on a string, and dropping the string to the ground, then we marked the string at the drop point. I took it down to the ground and measured it. It was 297-1/4 inches long.

Since I was not allowed to go on the roof, my dad dropped them, and I timed them with a stopwatch and wrote down the times. My sister Ashley picked them up and put them in a bucket that my dad would pull up to get the parachutes.



Photo 8: My sister helped me pick up parachutes

We did each parachute about 5 times. Sometimes they would get stuck in a tree or get stuck in the gutter. We took them down by using a rake. When I was ready to drop I would say 3, 2, 1 DROP. Then my dad would drop it and I'd start the stopwatch. I wrote the time down in a table.



Photo 9: Dropping chutes off the roof



Photo 10: This is me writing down timing data from drop tests

Once Ashley left it took a lot longer. She was a big help.

Later my dad helped me make a spreadsheet. Then I had to fill it in with the data we got from dropping the parachutes. These spread sheets are shown in tables 21, 22, and 23.

Table 21: Results from 1-Parachute Drop Tests

Payload #	Time (s)	Drop #	Distance (feet)	Descent Rate (ft/sec)	Notes
9	3.58	2	24.77	6.92	
8	2.49	3	24.77	9.95	
9	2.52	13	24.77	9.83	
8	3.6	17	24.77	6.88	
9	3.8	18	24.77	6.52	
9	3.47	26	24.77	7.14	
8	3.46	27	24.77	7.16	
8	3.46	36	24.77	7.16	
9	3.26	38	24.77	7.60	
8	3.22	39	24.77	7.69	
Average				8.54	

Table 22: Results from 2-Parachutes Drop Tests

Payload #	Time (s)	Drop #	Distance (feet)	Descent Rate (ft/sec)	Notes
2	2.82	4	24.77	8.78	
6	2.24	5	24.77	11.06	
7	2.2	8	24.77	11.26	
6	4.23	10	24.77	5.86	
2	3.2	12	24.77	7.74	
7	2.82	15	24.77	8.78	
2	3.23	19	24.77	7.67	
6	3.83	24	24.77	6.47	
7	3.57	25	24.77	6.94	
2	2.95	28	24.77	8.40	
6	3.15	29	24.77	7.86	
7	3.15	32	24.77	7.86	
2	3.4	33	24.77	7.29	
6	3.02	37	24.77	8.20	
Average				8.15	

Table 23: Results from 3-Parachutes Drop Tests

Payload #	Time (s)	Drop #	Distance (feet)	Descent Rate (ft/sec)	Notes
3	2.7	6	24.77	9.17	
4	2.65	7	24.77	9.35	
4	2.97	11	24.77	8.34	
4	3.12	22	24.77	7.94	
3	2.79	23	24.77	8.88	
4	2.49	30	24.77	9.95	
3	2.43	34	24.77	10.19	
4	2.69	35	24.77	9.21	
Average				9.13	

Results from the drop tests

The cluster of 2 parachutes worked best. The single parachutes worked ok and did drift far. The cluster of three parachutes worked dropped fastest. The drop test worked for finding answers fast and cheap.

List of any related R & D Reports previously entered by the author, if any, with brief summaries

This is my first R&D report. I have never done one on parachutes.

References to previous work done on the subject, found in research preparatory to this report

Model Rocket Design and Construction, 3rd Edition, by Timothy S. Van Milligan. Copyright 2008

69 Simple Science Fair Projects With Model Rockets: Aeronautics, by Timothy S. Van Milligan. Copyright 1996.

The equipment used

Two Altimeter One altimeters

Computer: to make parachute templates, view videos, making spread sheets, and to find areas of hexagons on intranet

Mini Thermo-Anemometer



Photo 11: Mini Thermo-Anemometer

Tape measurer

Stopwatch

Camera

Video Camera

Normal launch equipment

Normal Construction equipment

Electronic Gram scale

The facilities used

The facilities that I used are my house, our land in Canyon city, and Apogee.

The money spent on the project (budget)

Egg Sinkers \$1.36

Egg Sinkers \$1.36

Snap Swivel \$1.16

Barrel Swivel \$1.16

Snap Swivel \$1.39

D12-3 \$16.36

D12-3 \$16.36

D12-3 \$16.36

Quest Big Dog Model Rocket Kit \$42.79

Misc. items (string, plastic, white parachute rings, paper) \$5.00

Total \$103.30

The data collected

The data collected was listed in the steps above.

The results obtained

The result from this project was I got data that showed that two parachutes worked better than one or three. I got the data two ways, rockets launches and drop tests.

The conclusions drawn

I found out that two parachutes work better than one or three when all area is equal. But I probably would not use this in parachute duration because it might get in a big knot or be too fat to put in the rocket. Also, two parachutes weigh more than one parachute and that means it will fall faster because it is heavier. I can also conclude that folding parachutes is important so they don't get in a big knot.

Further work that would clarify or extend the results obtained

I would do more drop test from a higher place like the Royal Gorge Bridge in Cañon City, Colorado. I would build a better rocket that the parachutes come out easier.