# The Bouncing Spring

## Introduction

Imagine someone doing a bungee jump or someone bouncing on a trampoline and think what is it that keeps pulling them down and not letting them fly off, Gravity the most important force on Earth. What if we didn't have gravity, everyone would be jumping through the air, and people would take more than just one second to fall. Gravity helps objects fall and even if they intend to rise again due to a gain of energy such as elastic, that energy is converted into gravitational energy and this process keeps on going until gravity starts to become more powerful than the energy provided to keep the object up. My aim of this piece of coursework is to find out about the relationships between springs, gravity and weight. I must use as much scientific evidence as possible to prove whatever variables may occur.

Here are some variables for me to consider:

1. Counting the number of bounces and recording the times along with different weights.
2. Timing different number of bounces, using only the same amounts of weights.
3. Using longer springs and different weights and timing a fixed number of bounces for each trial.

Out of these three variables, I wish to choose the first due to that it seems to give out a bigger variety of results and as well as that, should be more interesting to do with the increase of weights per trial.

## Planning

*Equipment*

1 x crane
1 x spring
4 x 100g weights
1 x stop clock
1 x weight holder with 1 x 100g weight

The method for doing this practical is as follows. First I would set up the equipment and below I have drawn I diagram to represent their layout.

First of all I would adjust the claw to a considerable height and then place on the spring by putting the claw through one of its coil ends and then tightening it. Now depending on the amount of weights I would require such as 100g. I would place the weight on the weight holder (although the weight holder already has a 100g weight) and then after this I would clip it onto the bottom part of the spring's coil. I would hold up the weight to stop the spring from stretching until I let go of it, start the stop clock and then count and time the bounces at the same time. After finishing the number of bounces, I would stop the timer, record the results and add on take off a weight and go through the same process again.

I think I'll use 500g worth of weights because if I use too many, it could over stretch and damage the spring and also I intend to count and time 20 bounces which, in my own opinion seems to be reasonable due to the amount of practical time we have in class. Another things is that the time results will be recorded in the units of seconds with two decimal places and finally I will do three trials to ensure that the results seem to be equal, fair and whether there may be a/some outliers or extreme values (which I don't wish to happen) but to make it even better, I will produce a mean time from the three trials so it'll be better to evaluate and if the average seem to have a big decimal answer, I will round it up to two decimal places.

Before doing the practical, I'm going to consider the health and safety expectations and fair testing:

- I shouldn't use more than 500g of weights otherwise they could overstretch and damage the spring.
- I must keep the claw at a high level otherwise the heavier weights would hit the work bench, causing an unfair test so what I'm proposing to do is lean the claw over the work bench towards the floor so that the weights can bounce freely.
- I must not play with the weights otherwise they could end up injuring someone in certain body areas.
- I doubt I'll have to measure the weights but maybe if any of the weights seem to look dodgy I'll weigh them using a weighing scale.
- If the spring I am using seems to look a bit overstretched, I will immediately use a new spring due to that the overstretched spring would let the weights take longer to bounce, causing an unfair test.
- Another important variable I must take into consideration is the bounces and that I have to be accurate in counting them or otherwise the time could increase or decrease so I've decided to count the bounce just before the weight/s spring/s back up.

*My prediction*

I predict that the more weights used, the longer it will take bounce because in my general terms the stronger the weight with the more energy, the more gravitational energy produced (converted from the elastic energy) and this will convert back to the original energy and at first, the weight will use a great deal of gravitational energy, the weights will drop deeper and will take longer to cause one bounce.

I searched on the internet for a scientific prediction and came up with Hooke's Law and it came up with that the spring has a certain stretching limit/elastic limit which can be obtained by using lots of weights or leaving weights in a still position on the spring.

*Preliminary Work*

I did a practice practical before I'm going to the main one to see whether the results are suitable enough to proceed onto the main practical. I applied the same rules as I will use with my main practical and also considering fair testing. The results are shown below.

| Mass (g) | Time (seconds) |
|---|---|
| 100 | 6.86 |
| 200 | 10.35 |
| 300 | 11.69 |
| 400 | 14.23 |
| 500 | 17.11 |

From what I can see from the experiment, the times seem to be quite fair because it suits my theory and as well as that they seem to go in a reasonable pattern when the weights increase so I think it's ok now to go ahead with the main practical.

<u>Obtaining evidence</u>

*Results*

| | | Time | (Seconds) | |
|---|---|---|---|---|
| Mass (g) | Trial 1 | Trial 2 | Trial 3 | Average (c.t 2 d.p) |
| 100 | 7.66 | 7.59 | 7.21 | 7.47 |
| 200 | 10.21 | 10.95 | 11.08 | 10.75 |
| 300 | 12.06 | 11.90 | 12.32 | 12.09 |
| 400 | 14.66 | 14.54 | 14.81 | 14.67 |
| 500 | 16.35 | 16.50 | 16.51 | 16.45 |

By using these results, I am now able to create a line graph using the averages and make a line of best fit.

I should see a sign of a correlation and a pattern.

Analysing

The graph seems to show that there's a positive correlation meaning that the more weights applied, the more time it takes for 20 bounces. The number of weights for which it takes the longest to bounce 20 times is 500g whilst the shortest is 100g. The greatest difference of times was between 100g and 200g where the time rose by 3.828 seconds and the least difference was between 200g and 300g and the time only rose by 1.32 seconds. The trend line seemed to be quite above the results and crossing 213of the results so I can use this to say that there's a pattern for when another 100g is added, 20 bounces take 1-2 seconds longer. By using the line of best fir, I am able to predict how long it would take for 600g to bounce 20 and by looking at the graph it seems that it's an estimate of 192 seconds.

My prediction has been proved (the more weight, the longer it takes to break) and from looking at the graph, I can see that the time rising after every weight from 100g-500g.

Evaluation

Overall, I think the results seemed to be quite exact to my predictions and also I proved my prediction by using Hooke's Law. When I plotted the averages on the graph, all the the data seemed to be quite reasonable except for the 200g data and it seemed that it wasn't as close to the line of best fit in comparison to all the other data. Maybe if I did a retest I might've made new and better results or maybe even worse results.

One reason why I obtained poor evidence such as the 200g test was possibly because the weights didn't bounce straight and seemed to swing in the form of a pendulum; also with the heavy amounts of weights on the spring, they intended to hit the table which possible quickened the time but I noticed this on the preliminary work so I took precautions and made the weights bounce off the table and ended up doing fine. Maybe if I used the same method with all the other weights my results could've been better but in my own opinion I doubt it because firstly gravity is the same no matter how high or how low you are and secondly the lighter weights didn't hit the table, not causing an unfair test.

My conclusion seemed to be quite straight with no strange readings