

Can strong slap bands quickly roll up a  
sleeping bag?

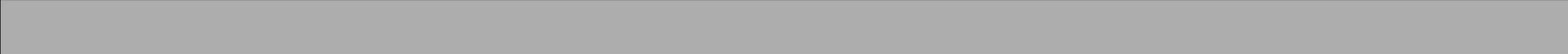
The self rolling sleeping bag experiment  
By Nolan Howard

# Science Fair 2020-2021

By Nolan Howard

My project is an innovation idea involving a self-folding sleeping bag. It uses technology similar to slap bands as it rolls itself into a tightly wrapped form. It unrolls just as easily for further use. I thought of it because when I was told to think of an invention or innovation I had to pack up a sleeping bag and it was annoying to put everything back up into a tiny little ball and fit it in a cramped bag. When I was done I figured it was something that just annoyed people and there was no solution to it. So that's how I gained the idea for my innovation.

Doing this will make things we all enjoy like camping or sleepovers so easy and organized.

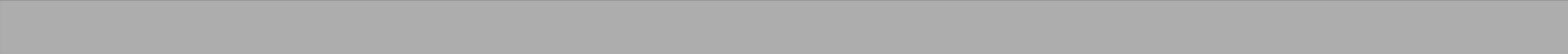


## Question:

How can I design and create a working self-rolling sleeping bag that is both efficient and time saving?

## Hypothesis:

If I put slap bands in a frame sleeve, then the sleeping bag should be able to self roll because the slap bands stress due to the bistable strain lifting the weight of the sleeping bag and roll it.

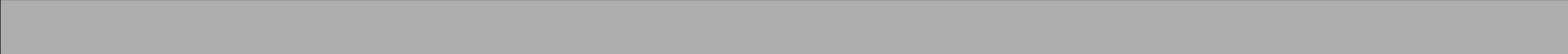


## Materials:

The materials I will be using for my project are the following

- Measuring tape 162cm
- Duct tape 164cm
- Screwdriver (1)
- Pillow case (2) 81 ½ cm x 51½ cm
- wood glue (1)
- Steel shears (1)
- wooden sticks (preferably thin) (2-6) 50cm long
- vice(1)
- buzzsaw (1)
- safety goggles

These are what are required for my project.





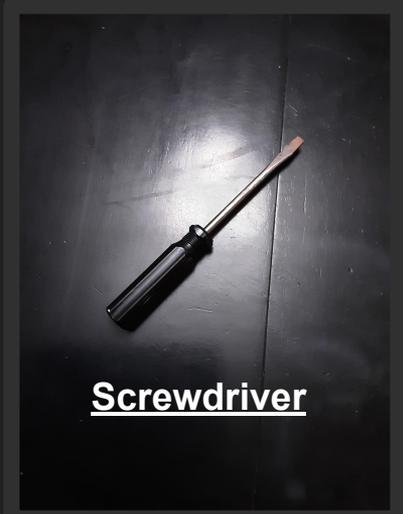
Duct tape



Oak wood paneling



Metal shears



Screwdriver



Pillow case and or sleeping bag.



Wood glue

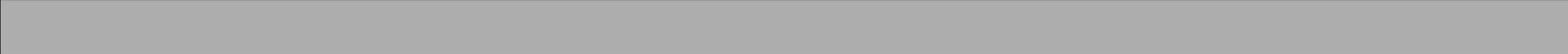


buzzsaw



Table vice

## Procedure:

- 1 Gather materials
  - 2 open tape measure
  - 3 pull out length of sleeping bag in the tape
  - 4 cut and repeat steps 3-4 until you have no more measuring tape inside the case ( all ends of the pieces of the tape measure must be rounded to avoid cuts using the metal shears)
  - 5 put screwdriver in between the jaws of the clamp (handle in screwdriver out) and tighten it until it's extremely solid
  - 6 bend one of the tape measurer pieces you made and put around the screwdriver in the clamp with the bump in the medal facing down
  - 7 keeping the two halves of the screwdriver lined up pull back and forth all the way up to the edge and slowly bend it the other way until it can roll like a slap band
  - 8 repeat steps 6-7 until all of the pieces of the tape measurer you made can roll like a slap band
  - 9 get out duct tape and take pieces of it with near identical length to the slap bands (2-3 cm more in length)
  - 10 set the bands in the middle of the tape and with the bump touching the sticky side of the tape and fold the remaining tape on the sides of the slap band gently onto the inverted side of the slap band then fold the remaining tape on the top and bottom of the slap band in and onto the slap band
- 

11 repeat steps 9-10 until all pieces have been wrapped in duct tape

12 get out the sticks of wood and prepare the buzzsaw and put on your safety goggles

13 cut the sticks into 9 different pieces (7 small, small being  $\frac{1}{7}$  of a stick and 2 large, large being  $\frac{1}{2}$  of one stick)

14 put the small sticks in between the big ones with a distance apart so that 6 spots the width of the slap bands can fit in between without being pushed down and glue them in place with wood glue

15 wait ten minutes for the wood glue to dry

16 repeat steps 12-15 a second time then move on

17 stick the slap bands in the slots with one of the stick slots at the bottom and the other at the top

18 get out sleeping bag (aka pillow case)

19 slide the frame into the pillow case

Variables:

Manipulated: How the slap bands are bent, where you push the frame to roll it, how the slap bands roll (roll meaning the top or bottom of the sleeping bag rolling up towards the opposite side), how strong are the slap bands.

Controlled: Amount of slap bands put in pillow case, how big the frame is, how much duct tape is used.

Responding:

The time it takes for the bag to roll up compared to the time it takes to roll up without the frame. And if the frame rolls.

## Background research:

How important are sleeping bags?

Some things I researched and discovered was that this has actually never been done or recorded before and this is the first design of a self rolling sleeping bag so far.

This could be very useful for most people because when it comes to camping sleeping bags are an essential to the process. Just in Canada there are an estimated 1 million families that enjoy camping and do it frequently, and in fact around 47 percent of all campers spend 51 to 200 canadian dollars and more on camping equipment.

When it comes to the importance of a sleeping bag it is held around the second of the most important items when you go camping it's a basic essential, the second most important thing to a tent.

## How do slap bands work?

How slap bands work is that slap bands have what is known as a bistable strain meaning its keeping itself flat but there is a lot of strain on it almost forcing it to roll into a circle. That is why slap bands and tape measures always have that small bend in the medal to make sure that it always rolls up. The reason it rolls up is because when pressure is applied to one part of the slap band it loses its strength and the entire thing collapses with it.

## Any other brands like this?

The closest thing to what I am doing is a small company called yoyo mats who used slap bands to make self rolling yoga mats (I thought of the idea before I found out this thing existed.) yoyo mats are currently valued at 80 dollars and only online but there is no such thing that has ever been marketed or released that is a self rolling sleeping bag. So my innovation is one of a kind.

## Spring steel:

Spring steel is what my slap bands are made of. Spring steel is a thin sheet of steel that is used for a variety of purposes. It is most often found in springs, tape measures, pianos strings and stage swords and many other items. Spring steel is often heat tempered and has different chemical compounds, because most of spring steel is heat tempered it usually has to be cut into long strips using a high powered laser. One other thing about spring steel is that it can resist extreme heat and extreme cold.

### How to “roll” a sleeping bag:

The official way to roll a sleeping bag is to fold it in half lengthwise and roll it down tightly top to bottom the way I am doing it I am rolling it tightly from the top down lengthwise. One group of people that this has also affected not only campers but cyclists to is the packing of the sleeping bag into the back pack. Bikers often have small backpacks for lighter transport and comfort the same thing goes for hikers to whom also carry small, light backpacks for faster travel and comfort. If I can roll a sleeping bag from top to bottom easily and have it retain its shape that could help change the struggle with hikers, campers and bikers.

### How I would produce this if I could:

There is the question for myself “should I sell it in a sleeping bag or just the frame and bands themselves?” after researching the topic I found that the average length of a sleeping bag for a male is six feet while for a female it is often 5 feet and six inches so I decided that I would produce it separate from the sleeping bag with the length of the strap bands being 5 feet and five inches. The strap bands and frame would be sold rolled up to avoid any mistakes with the packaging

## Should I leave the slap bands inside the sleeping bag?

For this question I looked at how many times a person struggles in their sleep. Doctors say the average human rolls over around thirteen times in their sleep. They do this because it keeps their muscles from getting stiff over the long periods of time people spend sleeping. Tuning in bed also can affect breathing by making it easier for you to more difficult. These studies were done by Dr. David Schulman by observing the sleeping patterns of the human. Based on these studies I can assume that the slap bands are to be removed from the sleeping bag before use.

## How well can this product work in different situations?

The slap bands and frame both I have made to last longer then expected. The slap bands are made of spring steel and can resist extreme heat and cold and the slap bands are very durable and can be bent and thrown and still adjust back into position for later use. The frame is made of a oak screen and is durable because the wood that makes it is oak and oak is known to be one of the most durable types of lumber and is used in many different items. If I were to produce this for a consumer I would put a water seal layer on each frame so it is protected from water and does not rot.

## Facts:

### Facts:

The sleeping bag was originally invented in 1876 and was called the “Euklisia rug”.

### Facts:

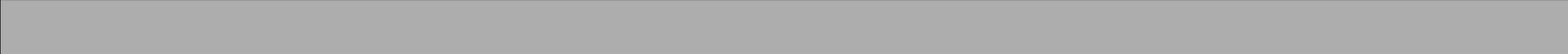
When you search how to roll a sleeping bag you will get 964,000 video results and 54,100,000 other results in total.

### Facts:

Slap bracelets were invented in America in 1983 by a teacher that was fiddling with a medal strip.

### Facts:

The sleeping bag market size is estimated at 427.2 billion dollars in 2017 and is predicted to grow in 2025.



## My expert:

My expert is Barclay Bertin a product development engineer and was student at the U of C ( a product development engineer is a person that goes through designs and corrects them and improves them so he was a great choice for my expert.) we met in person for these questions.

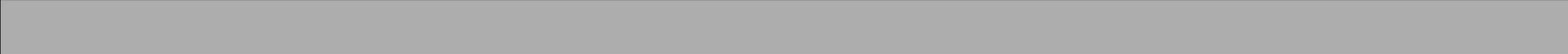
## Questions:

Me What if I stacked them?

Barclay- if you stack them they would compete  
if you stacked them on top of another that would get them to fight each other to roll all the way and it would not work.

Me- I tried stacking them they still rolled but seems slower. That must be why, but can you get them to be able to roll the same way the others do?

Barclay- you could try rolling them on top of each other that would make them able to roll just the right amounts to match the others  
(end of conversation)



(continuation of my expert)

Me- Who do you think will buy this product?

Barclay- Someone younger ( he said as an example of an age group 7rs old) children who struggle with cleaning up things like sleeping bags.

Me- How do you think this will work?

Me- Do you consider it to be useful?

Barclay- Sure it is useful it's a time saver

Me- What are some cons you can identify?

Barclay- If you add the slap bands and other materials it could make it heavier.

Me- What are some pros you can identify?

Barclay- It would definitely be a time saver for lots of people.

Me- How can this help people?

Barclay- Well for people this bothers it can make packing and unpacking so much more easier.

Me- Any changes?

Barclay- use wood to make the frame it is stronger and lighter and will do better in this project.

---

## Price?:

I will add the cost of all the materials and government tax and double the price like most other businesses

Tape measurer

Cost :

34.98 per 1 tape measurer

Duct tape

Cost :

36 cents for 164cm of duct tape

Oak screen moulding

Cost :

1.48cents for 2 oak screen moulding

Pillow cases

Cost :

6.99 for 2 pillow cases

Cost total: 43. dollars for all the materials used to make the prototype in this

Project. Plus GST 2.15 The final price would be 45.15 for the prices of the materials needed. Most sleeping bags

I saw had prices from the fifties to the hundreds. Depending on quality, warmth and design.

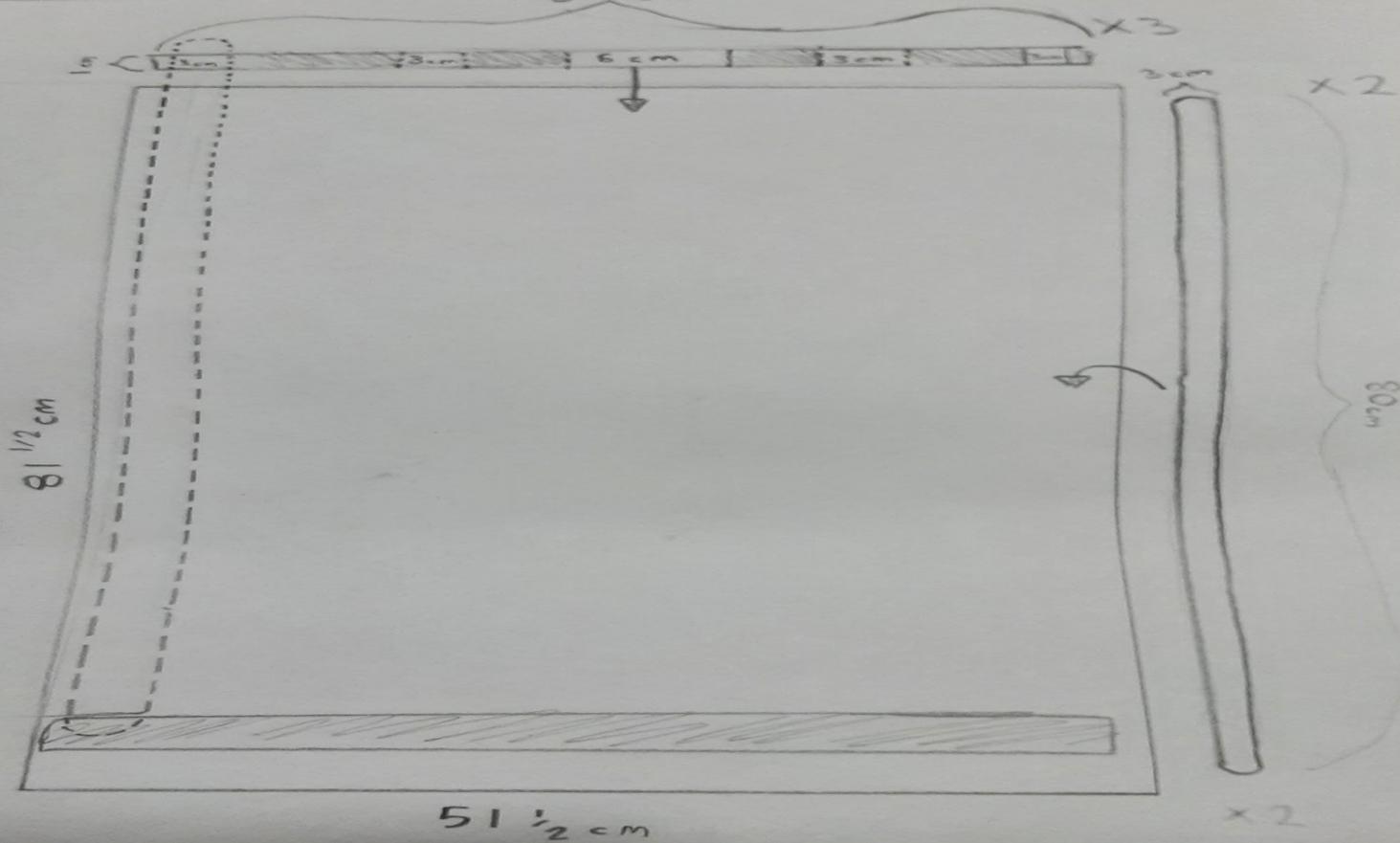
## Test 1 analysis:

After making all the designs reality to test the pillowcase/sleeping bag I tested it on a pillow case and it rolled in perfect unison and rolled it tightly in a time of one second so I believe that it is very successful. The time it took me to roll it was two seconds but it was rolled not as tight. I was able to roll the pillow case with slap bands so my design might work with a sleeping bag with some adjustments for the weight difference and length and width but I can say that the prototype test was a total and complete success. The cost of the prototype was 45.15 Canadian dollars. The following videos will show the results of test 1.

[20210126\\_181348.mp4](#)

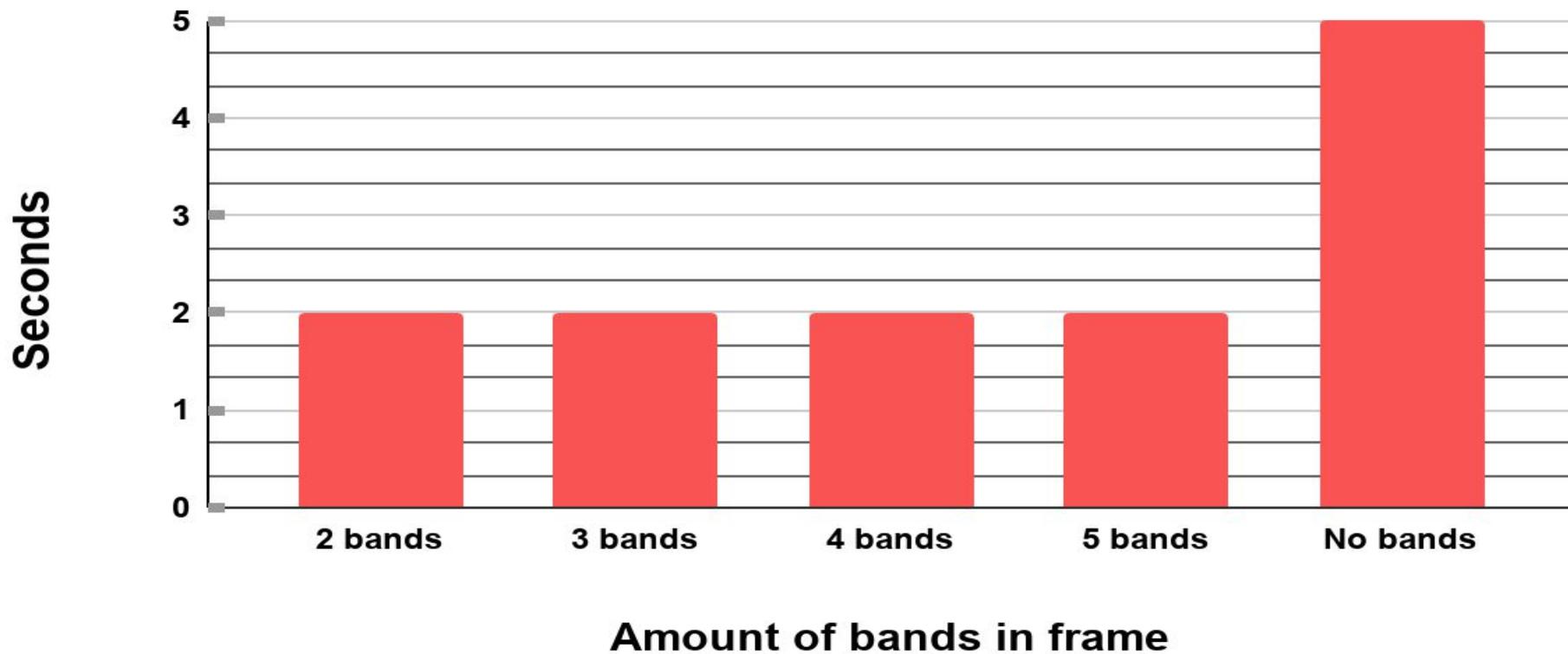
[20210126\\_181731.mp4](#)

Blue print A / C top 50 cm

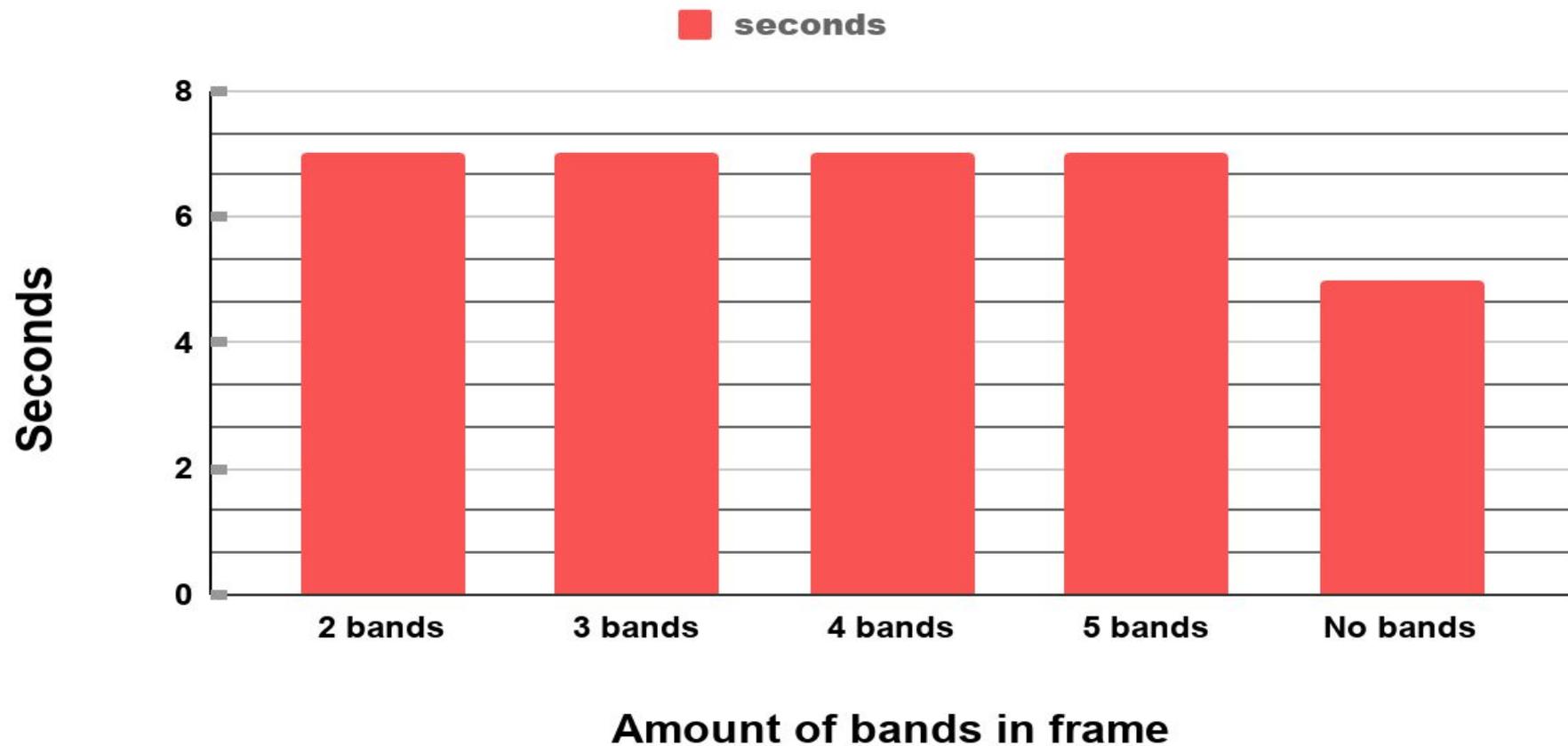


# Tests 1-5 (without frame)

seconds



# Tests 1-5 (with frame)



Here as you can see  
the sleeping bag  
retains its shape and if  
held at the top does not  
unroll

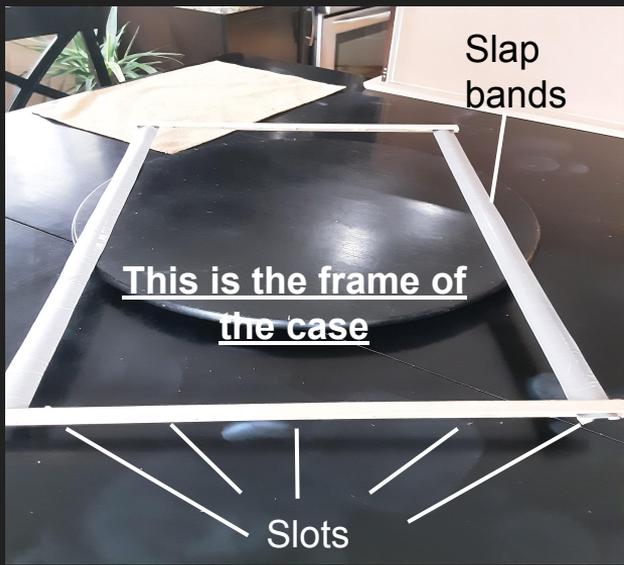
This is the  
frame



This is with two  
bands

Here the sleeping  
bag is held at the  
top and unrolls  
easily without  
retaining shape

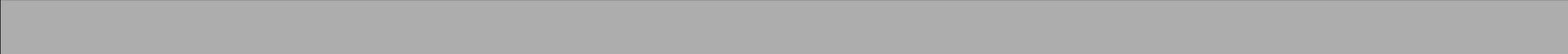
This is with no bands



## The final design test:

I decided to learn what would actually happen if I tried it on an actual sleeping bag. In reality one band per side was not going to work so what if you were to put the slap bands one on top of the other? I was conflicted to do this because putting them one on top of the other would mean that one would always roll quicker than the others meaning there would be conflict when rolling ( on rolls quicker because there is less distance to roll so it becomes dead weight to the other ones, and if they are duct taped together then when one stops quicker than the others it will pull back the others.) but a way to stop that problem is to when you are bending them to pull the one on top of the other so they are all comfortable with the distance they must roll. Then I will have to put them in a frame that will have to be very lightweight and strong and stretch the width of the sleeping bag to hold all the slap bands exactly where they need to be.

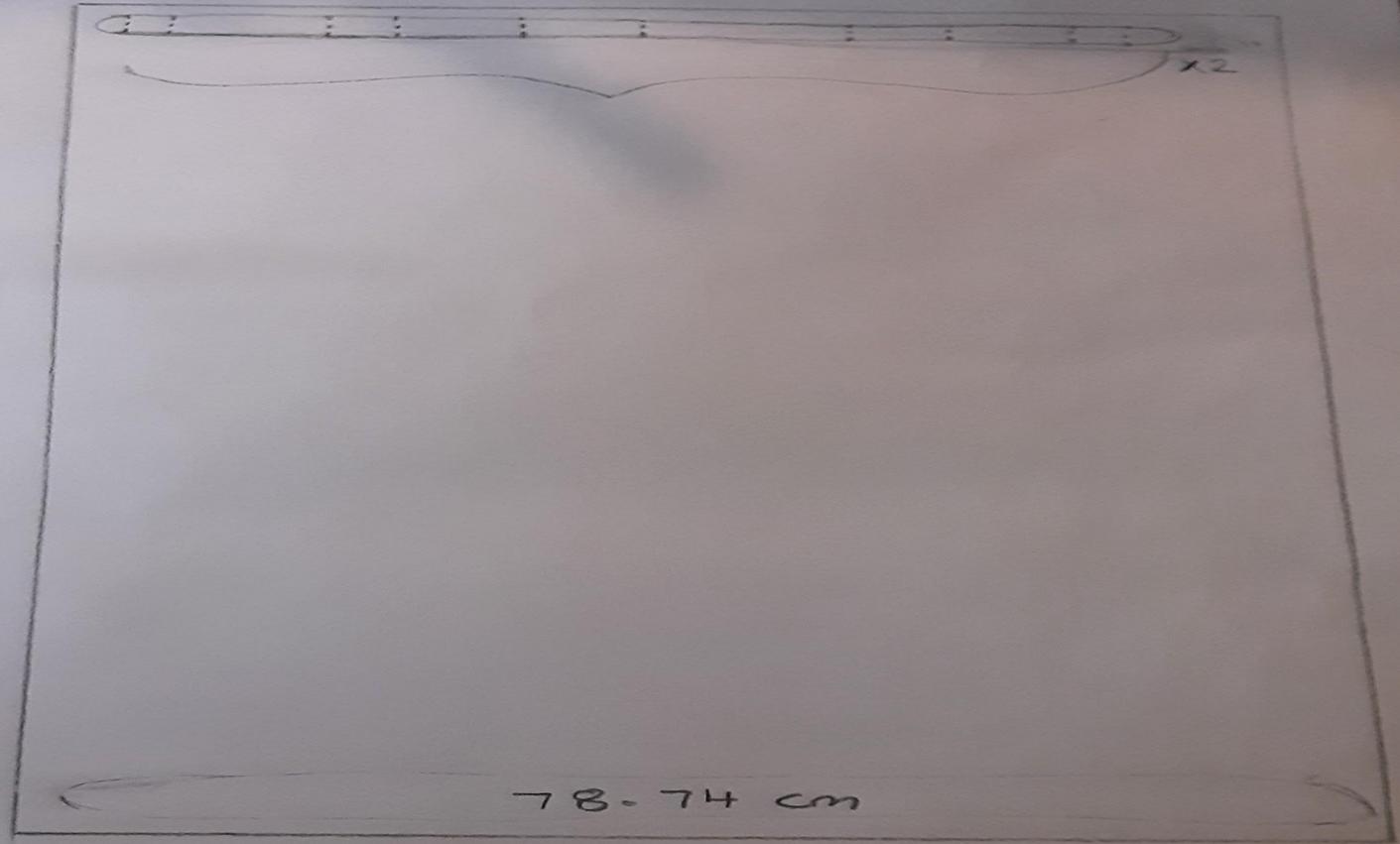
This is the final design blueprint



Blue print B: (large scale)

↓  
= 1

5 feet



78-74 cm

## How many slap bands should I use?

One question with the final design is how many slap bands does it take to roll the weight equivalent to a sleeping bags?

First I found the average weight of a pillowcase and the average weight of a sleeping bag. The average pillow case weighs 907.18g and the average pillow case weighs 200g. Then I compared these two weights to see how much more heavy a sleeping bag is to a pillow case. I answered this question by using the data I gained during my phase one tests to find how much one slap band can lift on it own, By seeing how many slap bands are needed to roll the pillow case (2) I used the following equation. (  $907.18 \text{ g} \div 200\text{g} = 4.5359$ .  $200\text{g} \div 2 = 100\text{g}$ . Each band can lift 100g so you need at least 9 bands .)

This means that a lightweight pillowcase can be lifted by 9 or more bands (  $100\text{g} \times 9 = 900\text{g}$ , a sleeping bag weighs 907.18 ounces.

The sleeping bag is five feet long and tape measures usually come with a distance of 25 feet so I could make five per tape measure. I think a good option for the project is to have eight per side to prevent it weighing itself down.

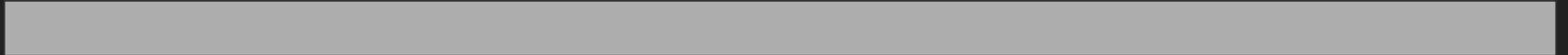
With all the slap bands I will make it should lift 800g but length could affect how it rolls because the length might make it weaker in the middle so I will have to test to see how it affects it.

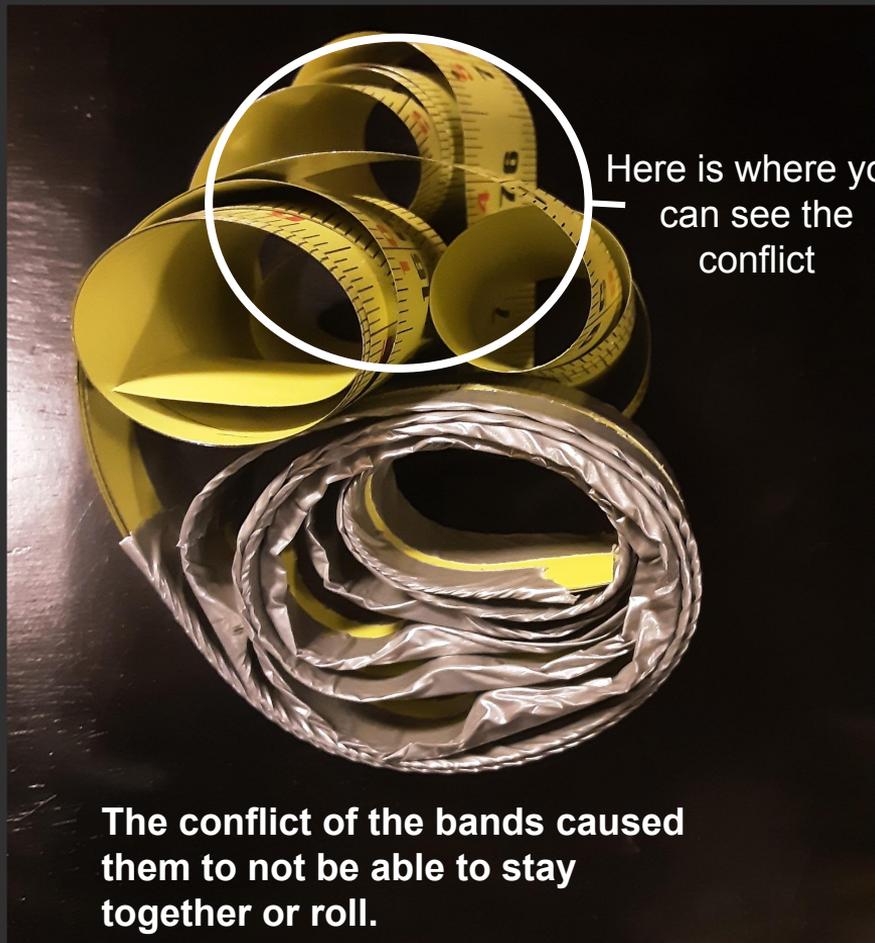
## Trial and error:

The Idea of rolling the tape measures stacked on top of one another was not successful. It still suffered by holding the other bands back, causing them to perform without success.

Bending them on top of each other caused them to also become weaker in some areas making it impossible for them to be outstretched. This is because when rolled in stacks of four they failed to roll all at once and created dents that pushed back on the frame, so they could not roll out without losing the resistance and rolling up.

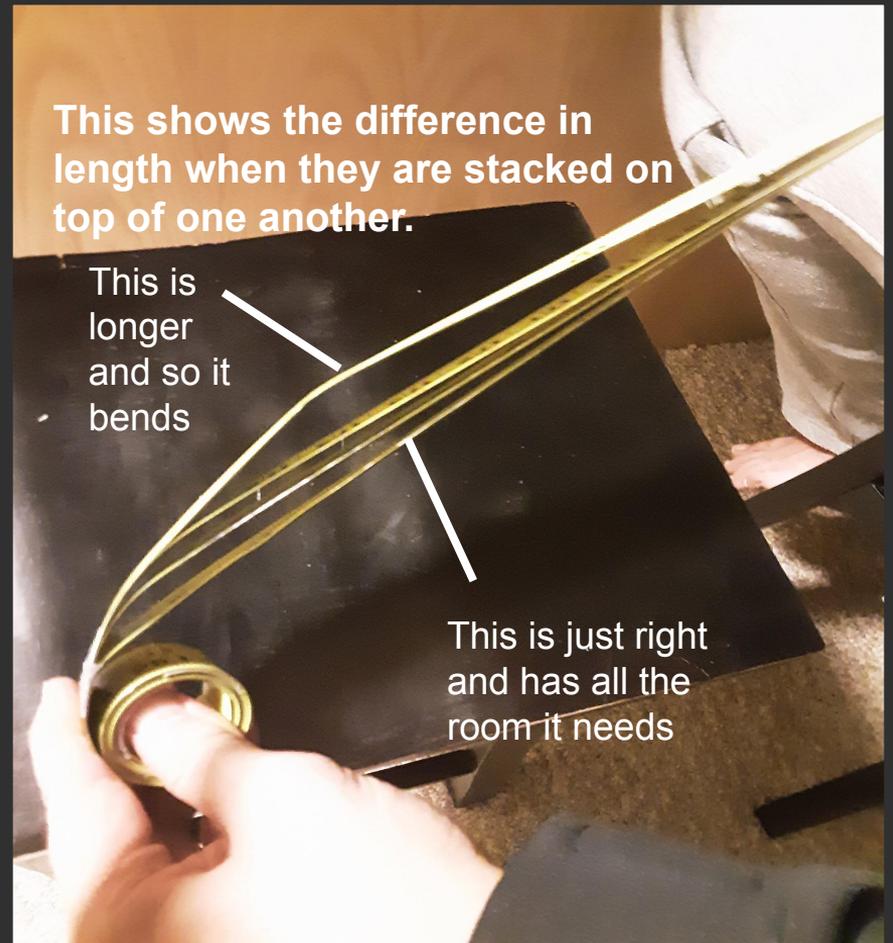
I was correct that this problem would arise and I believe that if I were to fiddle with the size of the slap bands I could avoid this problem in future testing. (longest band on top and shortest band on bottom.)





Here is where you can see the conflict

The conflict of the bands caused them to not be able to stay together or roll.



This shows the difference in length when they are stacked on top of one another.

This is longer and so it bends

This is just right and has all the room it needs

## Reflection:

In the end my hypothesis was correct, the self rolling sleeping bag worked and my design will succeed. Some outliers that could have occurred during testing are if I pushed on the bands in areas where they were weaker and that caused them to roll up quicker than if I pushed them in another spot. Some trends I found in my work is that I was able to roll my prototype in a time of one second whereas it took two seconds for me to roll it up by myself, this impresses me because it took half the time it took me to roll it. After my project the only thing I could not complete was my final testing, but I have tested and perfected a self rolling sleeping bag proving that my idea will work.

If I could do this again I would make sure I had extra slap bands on me so if some of them do not turn out all right I had backups to test with.

I also would have contacted more experts instead of the same expert numerous times and I would have changed the lengths instead of rolling them one on top of the other.

**Thank you for your time**

**And patience.**

# A special thanks to:

<https://www.youtube.com/watch?v=WYMUUpCNJpbM&feature=youtu.be>

<https://www.condorferries.co.uk/camping-statistics#:~:text=Over%20the%20last%20couple%20of.Americans%20going%20camping%20in%202018.>

<https://outsider.ie/gear/camping-checklist/>

[https://www.reddit.com/r/explainlikeimfive/comments/c277f0/eli5\\_how\\_do\\_slap\\_bracelets\\_work/](https://www.reddit.com/r/explainlikeimfive/comments/c277f0/eli5_how_do_slap_bracelets_work/)

<https://www.kickstarter.com/projects/yoyomats/the-worlds-only-self-rolling-fitness-and-yoga-mat>

<https://www.yogajournal.com/lifestyle/self-rolling-yoga-mat-slap-bracelet-meets-dog/#:~:text=The%20retail%20cost%20when%20it.as%20soon%20as%20this%20November.>

<https://www.gminsights.com/industry-analysis/sleeping-bag-market#:~:text=Sleeping%20bag%20market%20size%20was.used%20for%20outdoor%20activities%20fun.>

<https://www.homedepot.ca/product/dewalt-25-ft-x-1-1-4-inch-tape-measure/1000840076>

<https://www.homedepot.com/p/1-4-in-x-3-4-in-Oak-Screen-Moulding-HDO142/203364760>

<https://www.wayfair.ca/home/pdx/ornamental-mouldings-hardwood-shelf-edge-trim-panel-moulding-075-h-x-96-w-x-038-d-casing-pbwh1038.html>

<https://www.canadiantire.ca/en/sports-rec/camping/sleeping-bags.html>

[https://ca.manduka.com/pages/collections-yoga-mats?cid=401310022&aid=1302921529396023&keyword=yoga+mats&kid=81432742905590&msclkid=624cb98de6711469ef15e66fb816ba0b&utm\\_source=bing&utm\\_medium=cpc&utm\\_campaign=CA+-+Nonbr and+-+Yoga+Mats&utm\\_term=yoga+mats&utm\\_content=Yoga+Mats&](https://ca.manduka.com/pages/collections-yoga-mats?cid=401310022&aid=1302921529396023&keyword=yoga+mats&kid=81432742905590&msclkid=624cb98de6711469ef15e66fb816ba0b&utm_source=bing&utm_medium=cpc&utm_campaign=CA+-+Nonbr and+-+Yoga+Mats&utm_term=yoga+mats&utm_content=Yoga+Mats&)

[https://en.wikipedia.org/wiki/Sleeping\\_bag#:~:text=The%20%22Euklisia%20Rug%22%2C%20from.of%20the%20modern%20sleeping%20bag.](https://en.wikipedia.org/wiki/Sleeping_bag#:~:text=The%20%22Euklisia%20Rug%22%2C%20from.of%20the%20modern%20sleeping%20bag.)

<http://tenrandomfacts.com/slap-bracelet/#:~:text='Slap%20bracelets'%20are%20also%20known.fiddling%20with%20a%20metal%20strip> <http://www.springsteelstrip.info/>

<https://ksmdirect.co.uk/wp-content/uploads/QR162-Knight-Group-Carbon-and-Mild-Steels-Brochure.pdf>

