Assessment Task 2

Rube Goldberg machine

Class: 11 D&T1
Subject: Design and Technology

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1. Design Process

1.1 Design Brief

This project aims to create a Rube Goldberg machine that flows by Term 3, Week 7. The machine should consist of AT LEAST 5 mechanisms which create a chain effect where one trigger mechanism will start another. In addition, it should be composed of upcycled materials and AT LEAST one 3D printed mechanism.

Some examples of:

Materials:

- Recycled Wood
- Old toys
- Balloons
- Scrap cardboard

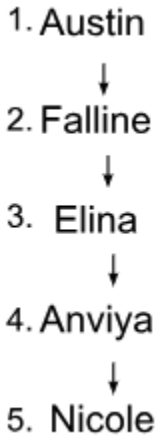
Mechanisms:

- Leavers
- Ramp
- Pulley

1.2. Group member Allocation

Participants:
Elina Chap, Falline Iwan, Anvia Joby, Nicole Xue, Austin Nguyen

ORDER: 1. Start - 5. Finish



<u>SMART goals</u>

Portfolio

Specific – The portfolio is completed with all necessary information
Measurable – The portfolio will be updated at least once a week
Achievable – Involves all relevant criteria
Relevant – Consists of all relevant information
Time-Bound – The portfolio will be completed by Term 3 Week 7

Practical

Specific – Mechanisms trigger each other flawlessly
Measurable – Through the use of trial and error with my prototypes
Achievable – The Rube Goldberg machine succeeds 2 times in a row
Relevant – Consists of relevant design factors to ensure a successful Rube Goldberg machine
Time-Bound – Within 2 months the Rube Goldberg machine will fully functional

Gantt Chart

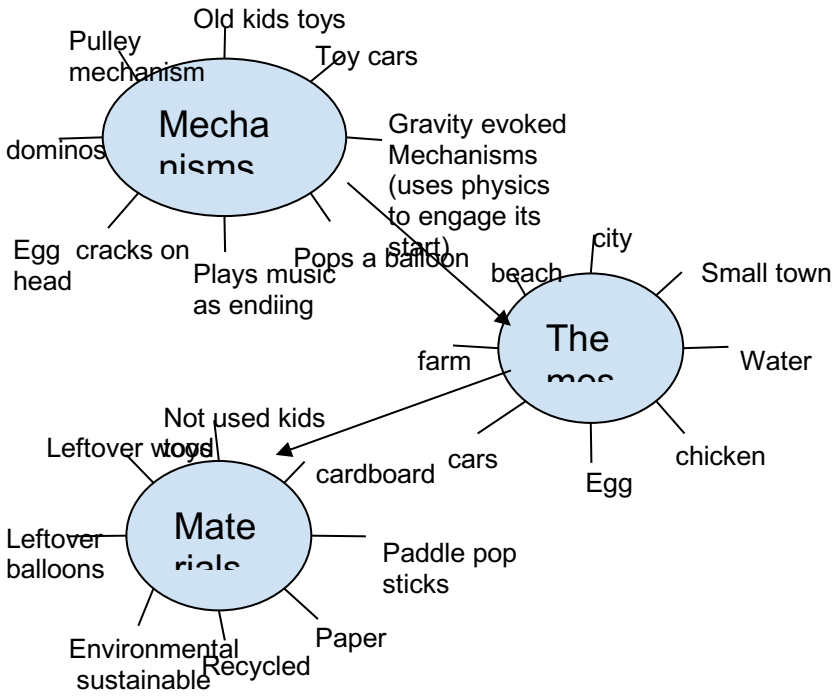
Term 2	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Research and design										
Collect materials										
Create 1st mechanism prototype										
Test 1st mechanism prototype										
Create 2nd mechanism prototype										
Test 2nd mechanism prototype										

Term 3	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Create 3rd mechanism							
Test 3rd mechanism prototype							
Make 3D piece							
Create 4th mechanism							
Test 4th mechanism prototype							
Create 5th mechanism							
Test 5th mechanism prototype							
Work with team							
Work on portfolio							

1.3. Needs and opportunities

Spidergram

The spidergram identifies ideas, constraints and opportunities for the creation of the Rube Goldberg Machine while considering the necessary criteria of the machine.



Evaluation

As stated in the design brief, the project must consist of multiple mechanisms which work in conjunction to another. However some **limitations** include:

- Gravity
- Forces of Objects
- And the impact of resources on individuals, society and the environment

By identifying factors which **need** to be considered, such as:

- The use of design factors impose on the project
- The selection of materials

It enables **opportunities** to further develop one's critical thinking skills and to find innovative ways.

- Design factors - Some design factors considered are recyclability, function or safety and health. By considering these factors, it sets a criteria for the appropriateness and success of the creation of the project.
- Selection of material - By using recycled/sustainable materials, not only does it reduce the cost of the project, but limits potential consequences for individuals, society and the environment. In addition, considering constraints such as gravity, it is important to consider the

types/shape/weight of the materials selected, as without specific/proper use of materials as it can cause the Rube Goldberg to fail.

1.4. Impact of resources used on individuals, society and the environment

Individuals

The impact of resources are foreseen as beneficial for individuals. By the use of recycled materials, it can contribute to the addition of increased jobs, wages and potentially cuts costs for. E.g. To recycle materials, we may need new jobs to accommodate these needs, allowing people to enter the workforce, and therefore earn wages. In addition, this project examines how the use of reusing already purchased or spare materials eliminates the extra costs of having to purchase new materials.

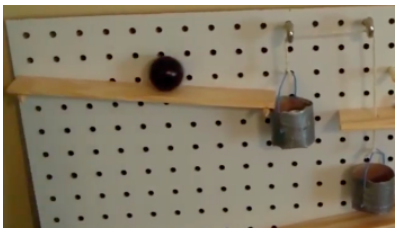
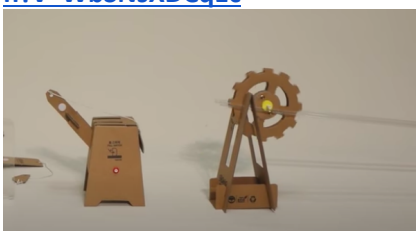
Society

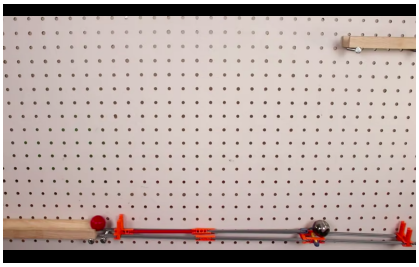
Through the idealisation of environmental stability, it enables society to develop their critical thinking skills. As seen in this project, it exposes how this mindset enables society to develop their understanding of the world we live in, enhancing their education and creativity in the process by identifying these issues and working around them e.g. issue = pollution (from littering), result = impose people with hefty fines, or taxing plastic products.

Environmental

The importance of this project demonstrates examples of how to create new ideas while keeping the environment sustainable and healthy. By substituting materials with recycled, old items or spare parts, it significantly contributes to the reduction of waste being sent to landfills, not only reducing energy consumption but also minimises the impact of a products life-cycle on the environment, ultimately preserving Earth for future generations.

1.5. Research and evaluation

Video	Plus	Minus	Interesting
https://www.youtube.com/watch?v=htJ8jV-bWIs 	+ triggers another mechanism + Creative + Continues 2nd mechanism at the same height level.	- necessary to have a wooden board to activate the second mechanism	May potentially weigh down one side to lift another sider to trigger a new mechanism
https://www.youtube.com/watch?v=vn-g1Mn2_3g 	+Allows mechanism to travel upwards or downwards	- will need a mechanism to knock down one domino to continue the mechanism. - High possibility of failing	Could use as the end of a mechanism to trigger another participant's mechanism
https://www.youtube.com/watch?v=WbSNsXDCqEc 	+Unique +Mechanism travels downwards at a slow and steady pace	- May be difficult to apply on an upwards platform/surface - Finding suitable pieces to create a mechanism - Needs a lot of trial and error	Needs a string to activate the mechanism, which will cause it to roll down and push another object to activate another mechanism
https://youtube.com/shorts/0F3F_YgvvXo?feature=share 	- Travels downwards -Can triggers a second mechanism when ball falls into cup -flows flawlessly	-Gravity, without enough force, it may not lift the platform enough to release the ball	The imbalance in the weight of the cup slightly lifts one side to trigger another mechanism, where a ball underneath is released.
https://www.youtube.com/watch?v=QsdLiAxDLAg	+ Allows the machine to travel upwards	- May take up a lot of space on the machine	Pushes another marble onto one side to weigh one side down to then

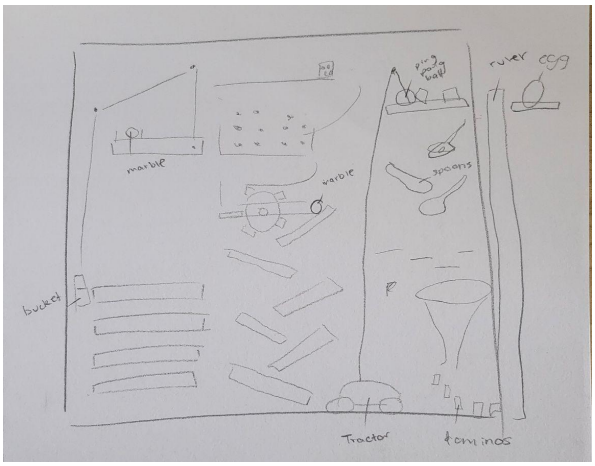
	+ Allowing another person's machine to start at the top		lift another marble onto a higher platform.
https://www.youtube.com/watch?v=vn-g1Mn2_3g 	+ Uses recyclable material + Spoons securely hold to marble as it is curved, preventing it from rolling outwards	-Without the right angle, the ball could potentially fall out of the spoon = fail	Good use of spare materials
	+Travels upwards +Unique	-Potential issues involving gravity	Despite being slanted, the marbles push the sticks moving the marble on top of the stick to move upwards

1.6. Resources used

Resource	*Pros*	*Cons*
Wood	- Strong and durable - Easy to manipulate its shape - Good for support	- Specific wood may needed e.g plywood vs plank wood (one is much thicker than the other which may be difficult to make thinner) - Needs appropriate machinery to shape it (can be costly)
Screws	- Durable - Easier to drill into board verse screws - Enables string to easy move against without friction holding it	- Needs machinery to drill - Can potentially cause injuries if not used appropriately/carefully
Hot Glue gun	- Strong and durable - Used for anything	- Potential burns when used - Some glue guns may be faulty (due to other classes)
Marbles	- With a round surface, easy to use in conjunction with mechanisms - Durable - Depending on size, can be a good use of weight	- Potential dangers, if left unattended on the floor, individuals may be subjected to falls
3D printer	- Meets marking criteria - Can personalise dimensions - High quality/durable	- Measurements may unpredictable (expectations may have expected it to be smaller/larger than reality) - Time consuming process of creating a piece - Material used in conjunction of the process is costly

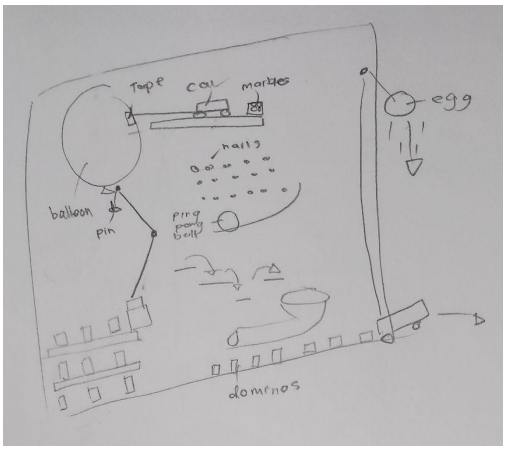
1.7. Sketch Ideas

Design 1



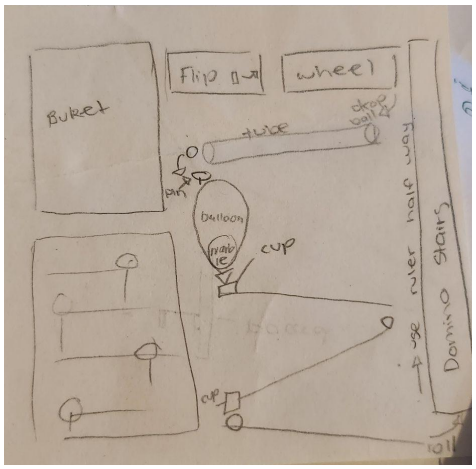
Plus - Has a variety and unique set of mechanisms, includes 3D printed object
Minus -Gravity may be a external influence affecting the functioning of the mechanism
Interesting - The component of the tractor at the bottom of the board trigger a mechanism at the top with minimal steps

Design 2



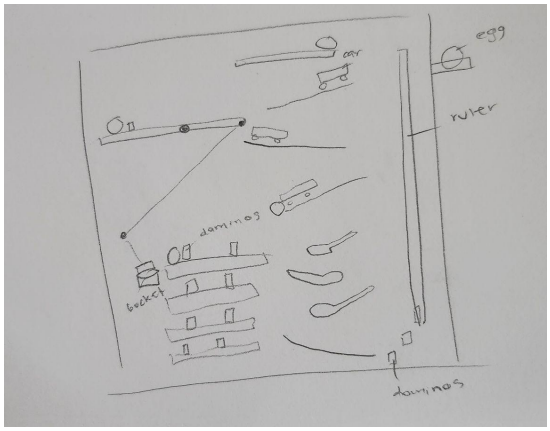
Plus- Unique variety of ideas
Minus-A lot of empty areas on the board, may not be enough mechanisms, balloon idea may be difficult to deal with
Interesting- The balloon popping by the thumbtack, which then releases a toy car to trigger another mechanism.

Design 3



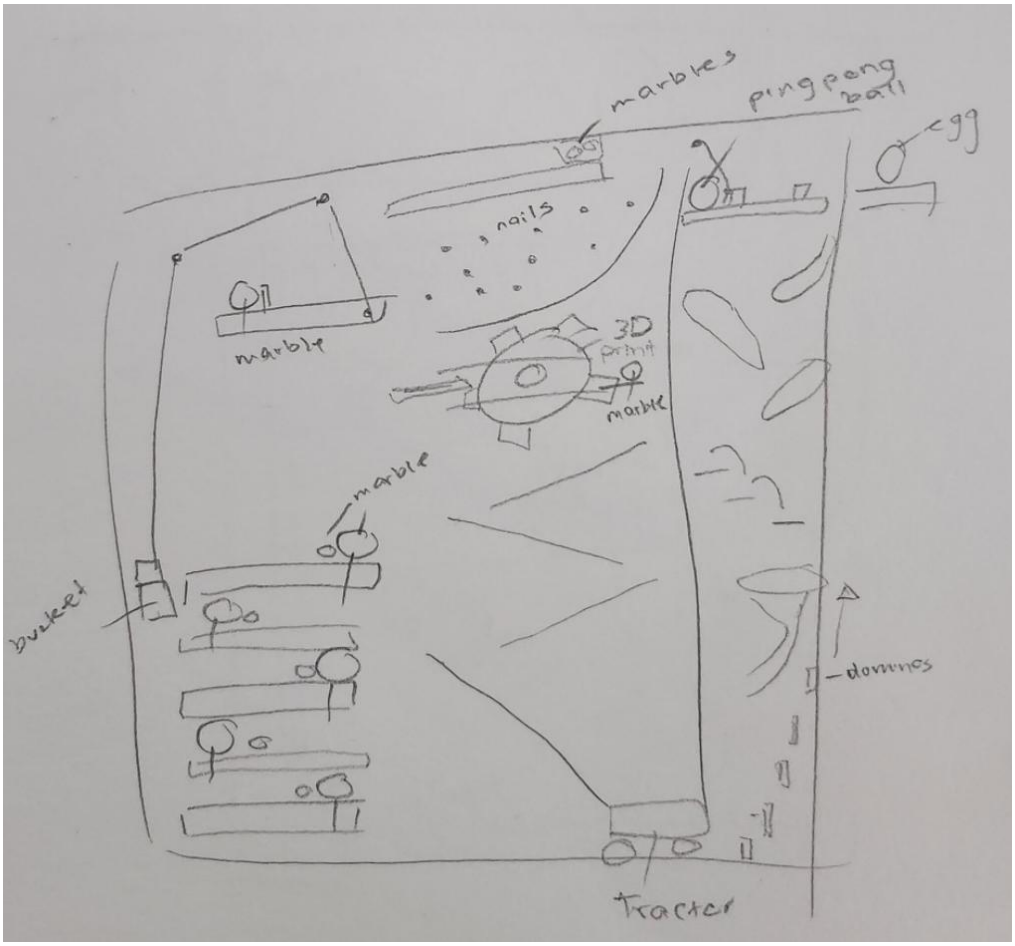
Plus-Uses a 3D printed mechanism (fits marking criteria)
Minus- May not be enough mechanisms as well as some mechanisms seem too simple
Interesting- The use of a balloon popping, releasing marbles and triggering another mechanism

Design 4



Plus-Unique composition of mechanism ideas
Minus- May not be enough mechanisms, does not compose of a 3D printed mechanism, gravity may be a constant issue present when trigger and ending some mechanisms
Interesting- The 2nd mechanism, weighing/pulling down one side, making one side unbalanced and causing that side to lift a marble up and trigger another mechanism

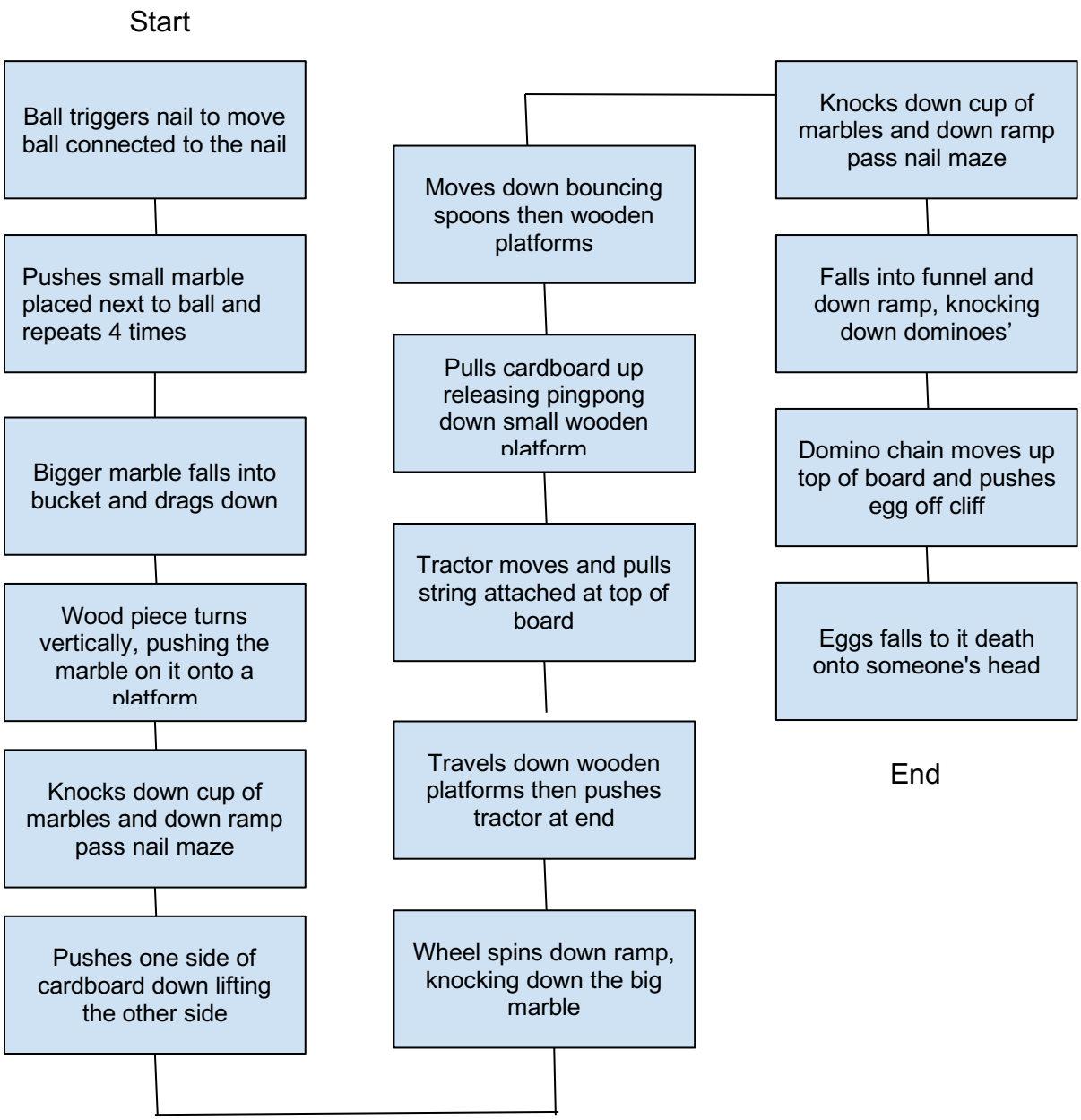
Design 5 (Final design)



Formulated from other design sketches, I have completed my ideal plan for creating a rube goldberg plan with multiple interesting/complex mechanisms, however as there has not yet been a prototype, all details may not be finalised where some touch ups or complete changes may occur throughout the creation process.

1.8. Function and sequence

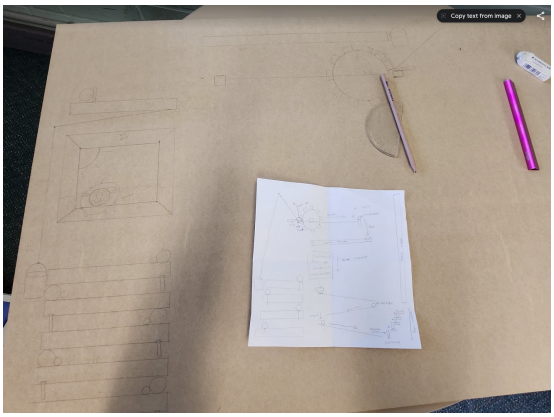
(insert flow chart)



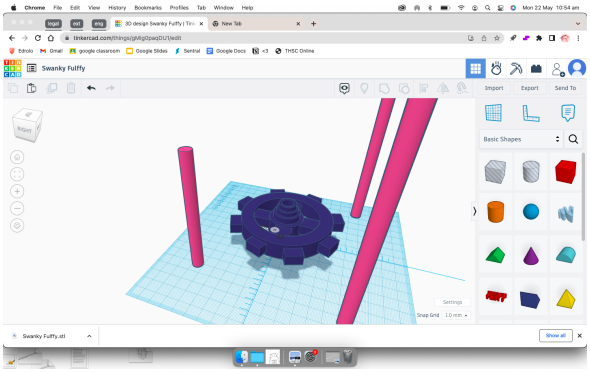
tPractical

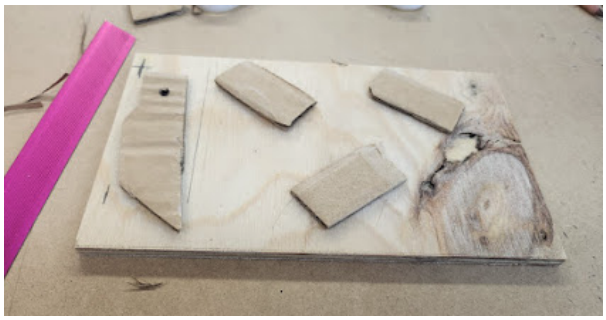
2.1. Planning and creating process

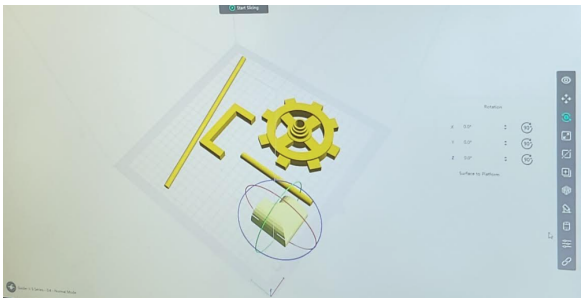
1)Sketching placement of mechanisms on board



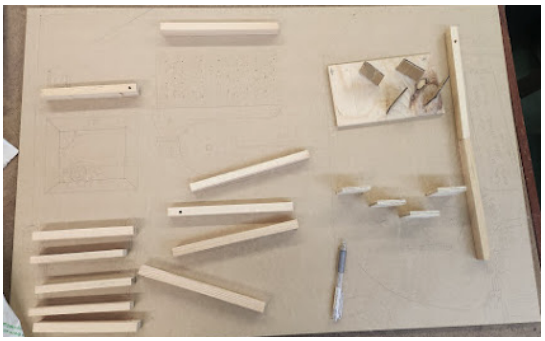
2) Selection + creation of materials

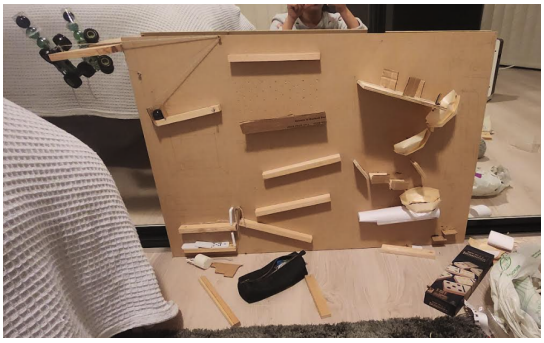






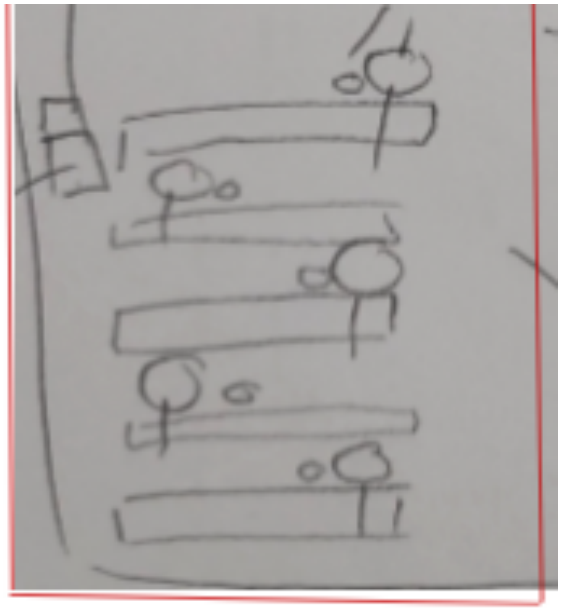
3) Building process + planning





2.2. Mechanism 1

Original design



Contents

- Five wooden platforms with holes placed at certain end sections, where large marbles attached to a nail would be inserted into.
- Next to the big marbles would be smaller marbles
- When the nail is knocked by a small marble, it will cause the marble at the top to sway the opposite side, moving the other small marble next to it, and therefore create a chain effect.

Troubleshooting issues

There was a lack of force for the big marbles to give enough momentum to push the nail on the other side to start a chain reaction

    + To combat this issue, I had made larger dents in the drilled holes to give enough area for the nails to move back and force

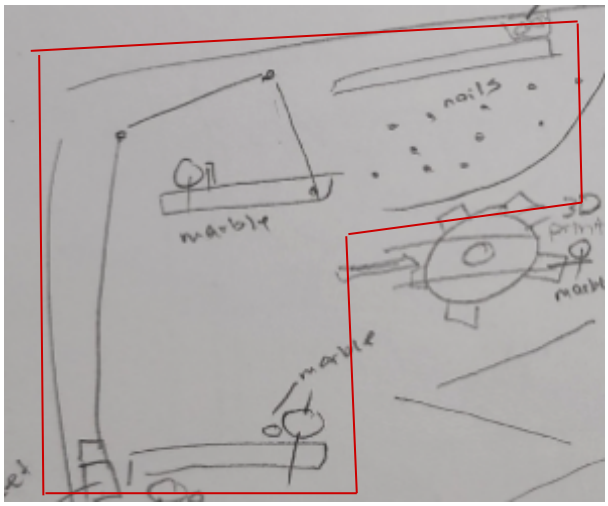
- Despite multiple experimentations/evaluation and modifications, this only allowed a chain reaction for 3 platforms due to the slow lack of force to push the other nails
    + To ensure this mechanism was fully functional, I had decided to formulate another mechanism which could have less complications.

I had changed this section of the mechanism into a domino chain effect, using up-cycled dominos in my cupboard. However to ensure it was a chain effect, I had to formula how to get one domino set to trigger the one above. By doing so, I had hot glued cardboard pieces with string attached to the domino.

As the end domino falls, the string will pull where the domino below the string will be pushed, causing it to start a chain reaction

2.3. Mechanism 2

Original design



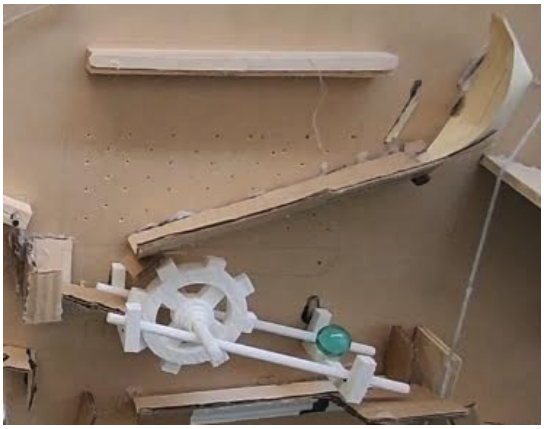
Context

- The marble at the end/top of the platform would then fall into a bucked, weighing it down, then pulling the string down, lifting up a second platform above vertically in the process
- The marble on the second platform tilting will cause it to be pushed onto a third platform and then push a cup of small marbles into a nail maze, then fall down another ramp and then push down a piece of cardboard, triggering the second mechanism.

Troubleshooting issues

1) The lack of weight in the bucket to successful lift the platform high enough to reach the third platform
    + Due to this, I decided to use my tractor as more support.
        - I had placed overloaded multiple marbles into the bucket, however, there was still a lack of weight.
    + To make it heavier, I created a spare platform, attracting the bucket and 2nd platform, when the marbles drop, the tractor would be on the edge of the spare platform, falling, then lifting the 2nd marble with enough force to roll onto another platform.
    + To ensure the mechanism would work 100% without fault, I had attached additional marbles to the tractor.

2) Due to limited cost and improper function of the nail maze, i had decided to scrap the idea and continue it with the ramp which the marble rolled down, flipping the cardboard the trigger the second mechanism

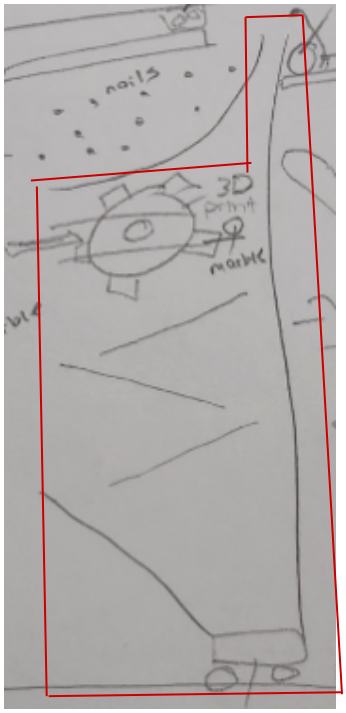


2.4. Mechanism 3

Original design

Context

- The 3D printed wheel would spin, knocking down the marble which will roll down the wooden ramps, pushing the tractor to pull the string attached above and remove the cardboard piece blocking the ping pong ball from moving



<u>Troubleshooting ideas</u>

1) The wheel lacked enough force to knock down the marble
   + To resolve this, i had placed the 3D mechanism on a higher tilt
     - However, due to the tilt, there were issues involving preventing the wheel from already triggering
   + I had resulted in hot glueing small blobs on the ramp to hold the wheel in place enough to hold but also so it could still be pushed off to trigger flawlessly

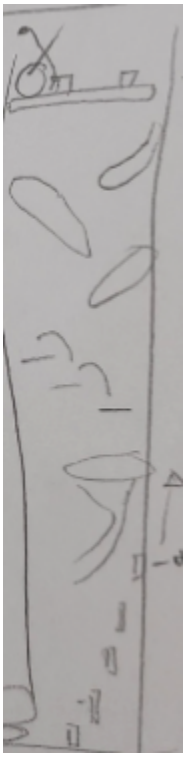
2) Lack of space between wooden ramps
   + I had detached and re-hot glued the ramps with enough space for the big marble to easy roll down without stopping

3) Without a spare upcycled kids toy, I had used spare equipment to replace it

+ I has attached a cup of marbles to a wooden piece to give it enough weight to pull the string to release the piece of cardboard holding the ping pong ball in place

2.5. Mechanism 4

Original design



Context

- The ping pong ball would roll down on the platform while knocking into cardboard pieces then fall into a set path of spoons and bounce down into a funnel.
- The funnel will direct the ball in a way where it would eventually hit the dominos, creating a chain effect.

<u>Troubleshooting ideas</u>

1) The ping pong ball idea worked perfectly, however the mechanism did not always work flawlessly. Sometimes it would work and other times it would fail.

- Through multiple experimentations and evaluations, I had altered some areas in the design, adding additional areas which blocked the ping pong ball from directing to an unintentional area, or by tweaking certain angles the material was placed.

2)As dominos had already been in use, I had replaced it with another ramp and had the ping pong ball trigger a marble to fall at the end, ensuring that when activating the last mechanism, there was enough force to knock it down.

2.6. Mechanism 5

Context

Having my second last mechanism at the bottom with little room left on my board, I had originally planned to have dominos to create a staircase, eventually leading to the top of the board and pushing the egg at the top to plummet onto someone's head.

- However, with limited resources and lack of space, I had resolved to use a long plank of wood which the marble on the last mechanism could push, with enough force, knocking down the egg.
- In the process of finalising my design, another issue had occurred. When the plank was falling down, it had fallen sideways instead of the directed area. As a result I had decided to glue a string attached to the plank in hope of the egg falling just as the plank did. II had also added a fence where the egg was rolling to ensure it did not tilt in the process.

2.7. Teamwork

Though the use of a collaborative working group, it had acted as an additional assistance in my design process. This included:

- Second opinions
  After completing sections of my project, I received comments both positive and negative, enabling me to critique areas which needed further development to ensure everything worked 100% of the time.
- Resolving present issues
  While identifying issues present in my design project, I had communicated these aspects with my group, where we had formed ideas to resolve the issue. By combining these ideas, it has enabled me to continue with my project into what I have accomplished now.
- Aiding in the creation of my project
  Limited with few recycled/upcycled resources, I had received additional pieces to create my project, as well as, with areas needing more than two hands, I had help from my group e.g. holding something in place so i can hot glue it.

2.8. Evaluation

Individual

1. Was my machine successful? Explain why or why not
   Yes. Despite the machine originally lacking in several aspects, by the use of experimentation, evaluation and modification, I had enabled me to update my machine to ensure it was fully functional at all times with few to no faults.

2. Which mechanism worked the best? Explain why
   The fourth mechanism was the best/easiest to work. This is due to there being little to change through the production stage, and also being fully functional the majority of the time. By incorporating minimal changes, the mechanism had become fully functional, while also including simple yet slightly complex ideas.

3. Which mechanism worked the least successfully? Explain why.
   The second mechanism was the most difficult to work successfully. This was mainly because the tractor which would fall down had a 50/50 ratio to falling successfully due to the lack of weight pulling it down or the tractor being caught on the platform.

4. If I could make my machine again, what would I have done better? Explain.
   If I were to make this machine again, I may choose to include a few less complex ideas, as despite having looked appealing, it significantly increased the difficulty level in its production.

5. Overall, are you happy with your Rube Goldberg machine? Explain why or why not.

During the starting process, I had been very unsure about the outcome, however once finalising my machine, I am very satisfied with the result where not only is my machine fully functional, but also includes a variety of unique and diverse mechanisms.

Group

1. When all machines were connected as a group, did it work? Explain
   Originally, once connected as a group, it did not work in conjunction with each other. Some of the issues present may have been due to insufficient collaboration in the beginning of the project. Once discussing and amending the project as a group, all machines had successfully triggered one another.

2. Was there a section of the relay that worked really well? Who were the students that created the machines that worked well?
   Sections that worked efficiently included Anviya's last mechanism triggering my domino chain which continued my whole machine, as well as Elina's beginning of her machine where once Fallines last mechanism triggered Elina's first mechanism the marble would smoothly roll down a spiral ramp, knowing down another mechanism to continue the machine.