

Team #7 (The Flying Pig)
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 KIS International School
 Design Cycle Challenge 2013

DCC Report

Design Brief:

We will be creating our own Rube Goldberg machine, which will then connect with the other group's machine through using dominoes. During creating stage, this will be proceed through using various materials/objects provide either from school or our bring-in materials (e.g. cloth hanger, plastic bottles, paper, etc..) where we will be collaborating as a team. Our main goal is to successfully achieve in producing KIS mini Rube Goldberg of 2013.

Inspiration - What is our inspiration? How does it reflects the principles of the assigned visual stimulus?:



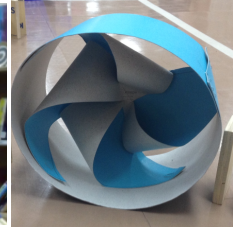
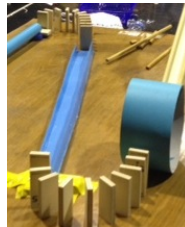
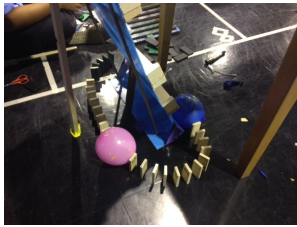
Inspiration Object is base on our assigned picture for team 7, which is a picture of a windmill. Due to this we were inspired to include spinning action as a metaphor of the spinning windmill when the wind blows and make some benefit out of it as it helps to activate the next object in our machine. From this it helps to reflect our group's visual because as we all know when the windmill spins, it generate energy, but in our machine's case we make our own windmill that will help to generate enough force to push the object instead. We use blue poster to make the windmill and form our

design. Meanwhile, it was now used as a decoration. Due to this we were able to reflect on the principles of the assigned visual stimulus. The main color that we use are blue color, since the the background image of the visual we are assigned to are mainly blue color, which represents the sky and the cloud (in the surrounding environment).

Design Specification:

No. (#)	Design Specification
1	Must start and end with domino, which enables the Rube Goldberg machine to connect with the other team's machine (for continuation). Test: Picture of the Rube Goldberg machine (start and end section).
2	Must relate to the theme/picture assigned for Group #7 (picture of windmill and surrounding environments), e.g. eco-friendly material & spinning action. Test: Pictures of the section that represent that our machine is relatable to the theme.
3	Use 6+ different kind of materials/objects, either the one provide from school or things you brought from home to form a Rube Goldberg machine. Test: list of materials used in our Rube Goldberg machine.
4	3 Actions and 2 potential energy sources. Test: Video of our Rube Goldberg machine in the video reflection.
5	Must create a railway (with sides) in order to be able to guide the moving objects/materials. Test: Pictures of our railway/track used in Rube Goldberg Machine
6	1 working KIS Rube Goldberg machine (synchronize well until the end). Test: Video of our Rube Goldberg machine in the video reflection.

Proves for Design Specifications:



(start and end with dominoes)

(Railway/tracks)

(Usage of theme: windmill)

Material used for our final design:

Material Used:	Use for:
Future board	To make the railway and use it as the board for the zigzag section.
Dominoes (KIS)	To activate the next object (Arrange next to each other).
Stack of books	To create some height in order to successfully create a slope and to generate enough force for the car to hit the domino.
Balloon	Use as replacement for dominoes as a solution as we do not have enough dominoes to complete our Rube Goldberg machine.
Tape	Combining objects together using tape.
Pipe	For the marble to pass through, which enables it to reach the next object.
Wood	To make the railway; to withstand the weight of the zigzag board, and use as part of material used to make zigzags.
String	Strings tied to the book and the domino so that when the book falls down, the domino will also do, which then allows the clay to roll down the railway as the domino gets out of its way.
Clay	Use as replacement for some of the marble because with clay we can adjust the size, meanwhile there would be less chance for it to bounce off track and reduce force. This is use as solution since the problem with our old design is that the marble often bounce off track that our machine fail, also due to too much force since the slope is very high. We also use clay to create some slope as well.
Paper (poster)	To form the windmill (relating to the theme).
Toy Car	Toy car is used so that it could travel down the slope and hit the domino in order to continue the action for the machine to work.
Marble	Used as the traveler from one place to another, which then transfer force to the next object.

Introduction: Rube Goldberg

Rube Goldberg machine are made out of simple objects, in which every single moves has to be perfect in order to continue the action. If not, they can possibly make some mistakes. However, we can always

learn from the previous mistakes we made and improve on it in various ways to form a successful Rube Goldberg machine that synchronize, despite the fact that a lot of moves in Rube Goldberg machine tends to have complex combinations. It is a form of machine device that often requires creative imagination, sometimes used to complete certain simple task in the most complicated way possible, which opposites from the way we often view machine as the most efficient device as it perform a task in an inefficient way.



Rube Goldberg was a cartoonist, sculptor, and inventor, who was born in July 4, 1883. He was able to draw complex ways in transporting an object from one to another, which have many potential influences to people nowadays as it gives new knowledge about transporting one object to another efficiently and new engineering techniques. This invention of Rube Goldberg machine leads to amusement and fun ways to explore in terms of transporting that could be build by any age groups whether its adult or children.

Physics:

Use of Newton's law of motion - Newton's first law of motion, which was also known as the law of inertia was applied in Rube Goldberg machine as it states that an object will remain at rest or continue the motion in the same speed (velocity) & direction unless acted upon some unbalance force; for example, a marble will stay at rest unless something pushes it forward. Meanwhile the second law of motion states that the acceleration of an object are dependent on the force that was transfer towards the object, if there are more force, it would leads to more acceleration ($F=ma$). The third law of motion explains that every actions will be experienced by equal amount of strength and in an opposite direction, from this it could possibly be use in Rube Goldberg machine when one thing activates another that cause equal and opposite reaction, which was known as the "domino effect".

Momentum - As the Rube Goldberg machine starts, the object that is in motion transfer momentum to the next object that it get in contact with, then the process continues on as an object continues to hit another. More momentum could cause the performance of the Rube Goldberg machine to become more efficient.

Kinetic Energy /Potential Energy - Potential energy is a form of energy by height, as an object falls from certain height and hits the ground it then changes/convert into kinetic energy. We would be able to apply physic by having an object roll down from a slope, this would help it to gain kinetic energy.

Information from interviews:

What makes a good rube goldberg machine?

The main aspect that forms a good rube goldberg is the design and our creativity as it result in having a unique design from others that will definitely grab the audience's attention, which the creativity that we add in our machine could leads to a more successful and efficient design of the rube goldberg machine.

What helps to generate the force?

"Dominoes can fall creating acceleration to push another object" - Tim Cabrera

"Have a pulley lift an object will generate enough kinetic energy to move an object" - Tim Cabrera

"At the top of the slope is potential energy, which will create enough force when object rolls down" - Tim Cabrera

(We were able to apply this information into our design as we decided to add in two slopes in our rube goldberg machine by creating a railway)

Daily evaluation/reflection:

Day #1 (Tuesday) - On Tuesday we planned how our rube goldberg machine is going to be like. The improvements that we need was to design a machine that is long, long enough to get in contact and activate the next machine. We also need to put a spinning action in our machine as our theme is windmills and research more to generate new ideas. For more creativity we decided to have the table in our first design, which as a result, it works pretty well (smooth). Our goal is to improve on the consistence of our machine because sometimes it work, sometimes it doesn't.

Day #2 (Wednesday) - On Wednesday we thought about how to make a fan so that it spins like a windmill, how to connect our machine with other team's machine and what materials will be used to form the machine. To improve for more consistency, we decide to replace one marble with a toy car instead since it is more precise in direction its moving, which is straight towards the front, unlike marble that tends to have the tendency to turn sideways. We made a windmill/turbine out of paper and objects that will create some spinning action (e.g. a wheel). What we need to improve was to make the marbles roll down the right way from the top. It keeps going diagonally or jump off track that it doesn't hit the dominos, we also need to improve on the way we arrange the dominos because even a small mistake in arrangement could impact the entire Rube Goldberg machine. Today we also try to create other design of our machine without using a table, to explore new designs and make the final decision later for the third design.

Day #3 (Thursday) - On Thursday we decided to make our third design. We decide to use the old idea which is using a table. We also add in new designs by rearranging domino and making a zig zag on a future board so that the marble would be able to roll down from the table and hit the dominos to the other group. On the other section of the machine, we have the book linked with domino (using a long string where one end tied with the book and the other end tied with the domino) so that when the book drops, the domino on the table will also drops. The marble that is being block by the domino will then be released and hit the next object. From this section, the error is that when the marble reaches the bottom it would either goes sideways or bounce, so we change to use clay ball instead of marbles as a solution. We also make changes by rearranging the dominos and order of objects, for example, putting huge objects in front of dominos so that it would be able to handle the force of the object from higher point without losing track and successfully touches the dominos. Today we connected all of our rube goldberg machines with other groups and our machine worked very well and consistence, it is much better compared to before (2nd design), which from the old design it only make 2 successful machine out of 5. Our third design become our final design that we will be using.

Evaluation:

We tested our first design specification which requires our machine to start and end with dominoes by considering about connecting our machine with other team's machine while planning our design. We discuss some ideas with the group, which several ideas we came up with is to have dominoes stack up to the books (we use the book to form the steps/stairs) at the beginning of the machine, while have the marble hit the balloon that will then hits the dominoes at the end. We also tested the connecting part of our machine with other teams where every groups bring one action from their machine and combine them together to make a mini rube goldberg machine. From this our machine were able to form a successful performance on the first trial as we were able to end it with dominoes, enabling it to connect with other's machine that of course have impact on them as well since there must be something that will activate their machine.

We tested that we achieve the the design specification number two that our machine is connected and inspired by our theme picture through planning our designs creatively by forming a wheel-like object designed with windmill in the middle. This allows us to use object effectively without wasting any space (combination of wheel and our design of windmill together in one piece), and since our theme picture is

the windmill, we include the decorative windmill (made out of blue paper) and include spinning actions in our machine.

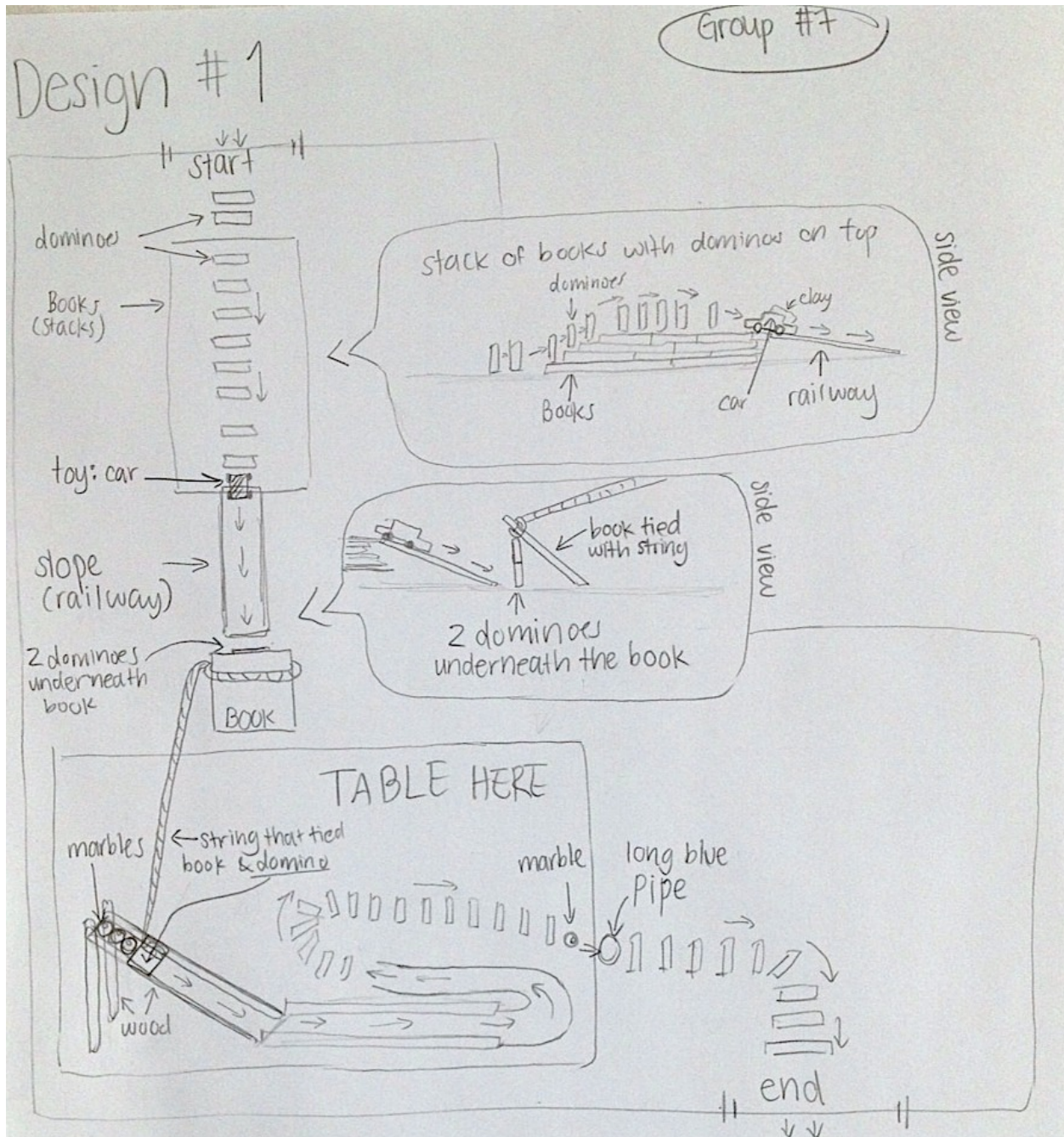
We achieved the design specification number three which is using more than 6 different kind of materials in the machine by discussing which objects will take part in what section of the machine; for example, we use future board to form a railway, which plays a significant role as we needed it in order to allow the marbles or the toy car to travel or roll down to generate enough force. We also try different kind of materials and choose the one that we are satisfied with. The combination of future board, wood and clay leads to successful machine, which many materials were used whether it's paper, string, dominoes, books and tape to create our Rube Goldberg machine. For the 3 actions and 2 potential energy in our machine, we brainstorm in our groups on where the source of energy will come from and what kind of movement and action we want to include in our machine before starting the create stage.

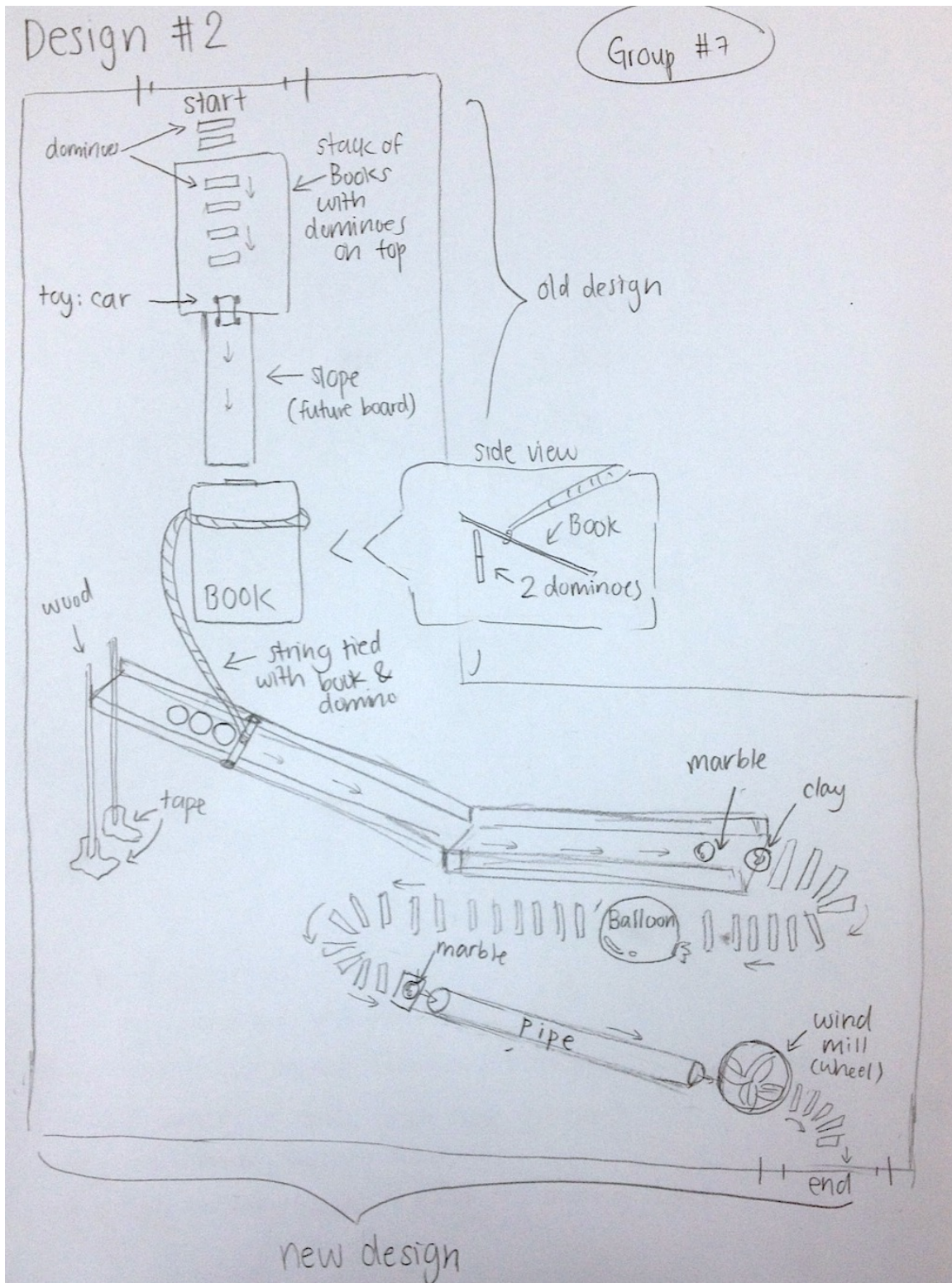
We make sure that our machine is a part of KIS Rube Goldberg machine by connecting our machine with other teams in the auditorium according to our team number order and try to improve and make our machine as consistent as possible since it is the main aspect that will verify our last design specification, which is "1 working KIS Rube Goldberg machine". In order to improve on this we try many different designs from working on the floor until working using tables to have two different levels (effective use of space); meanwhile our purpose is also to challenge ourselves for more creativity since if we only work on the floor it may be too basic and dull. At the same time through changes in using table, it gives more potential energy for the machine due to having the machine in higher point that will also be where the marble will drop from. For more creativity, we decide to add zigzag board that helps to kill more time, which defines Rube Goldberg as it tends to contain a lot of complex combinations (kills time).

Choice of Final design:

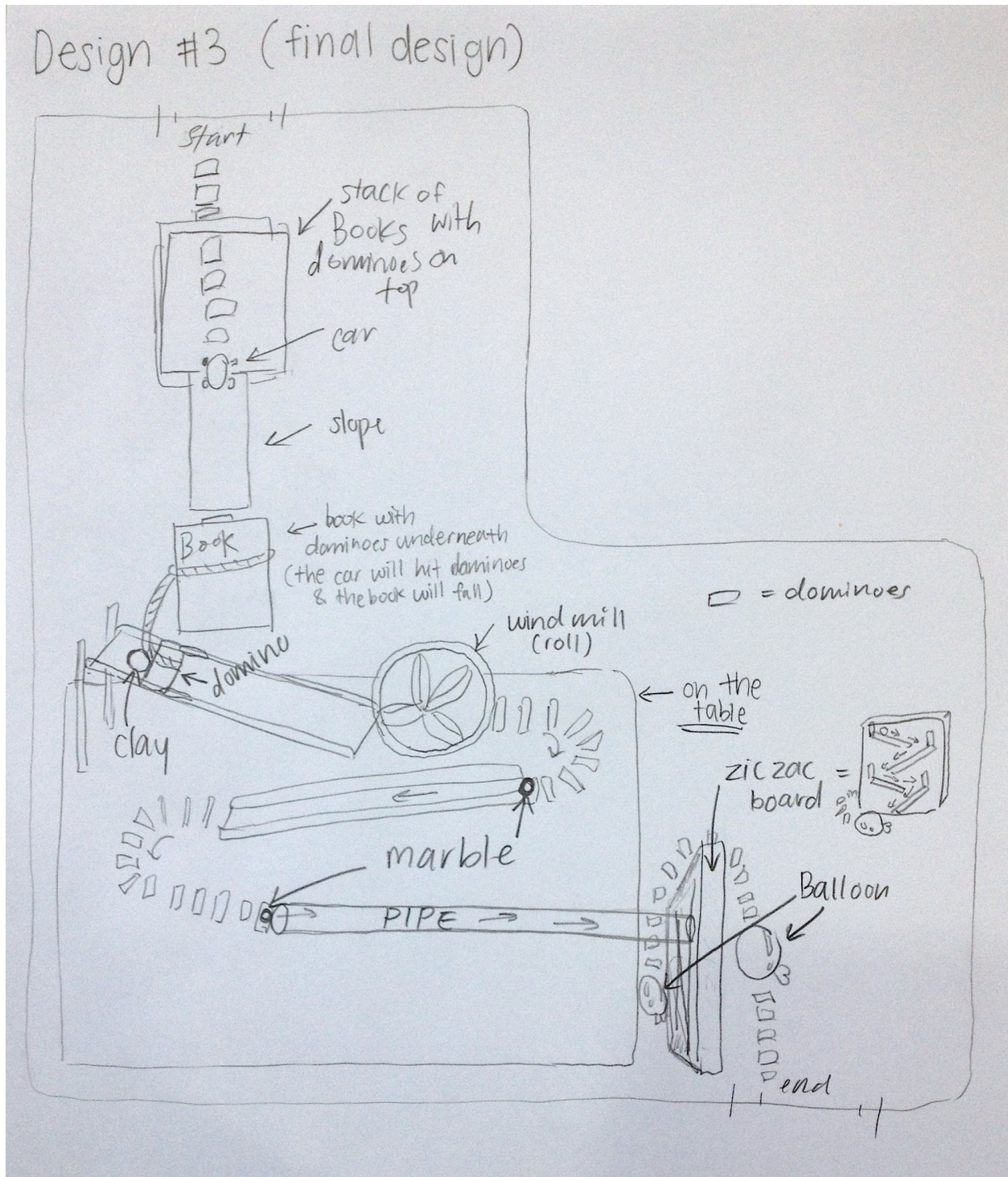
Our final choice of design is the third design because the third design is the improvements we made after learning the previous mistakes from design 1 and design 2. It also contains certain parts from design 1 and design 2, including new ideas that we came up with, this leads to an effective design where we keep the best part of each design and combine them together, which we decide to keep the table since it synchronizes well with our machine. From this third design we were able to successfully achieve in making a machine that works well, which at the same time also shows effective use of space and height (low & high). We choose this design because after we test several times, its tendency to fail are pretty low, which the pros about this is having more chance to success. The third design also shows more variety use of complex combination by adding in new design (the zigzag board). The rearrangement of the object for third design also have some slight difference from first and second design, allowing the machine to work better than before as we improve it little by little. Meanwhile another important reason why we choose this design is because we were able to fulfill the design specifications (start and end with dominos, relate to theme, use more than 6 different kind of materials, 1 working machine, railway with sides as a guide and 3 actions & 2 potential energy) as we tested and achieve the specifications. We also like the fact that our machine are giving the audience "moment" to enjoy and watch the slow moving object, it is good to have both speed up and slow down section.

Designs/Plan: All the designs are the ideas that all of us came up with, not a one person's idea, in which ideas from each person were being combined into one Rube Goldberg machine as shown in the design below. (There are three designs in total).





Changes made compare to previous design: We remove the table; rearrange the dominos (trying out new ideas); change the pipe to diagonal (works more efficiently & smoothly that also slows down the machine meaning take more time); add in balloons as a solution (running out of dominos) and add in new designs, which is the windmill (wheel) that will hit the dominos.



Changes made compare to previous design: We reduce number of marbles and replace some of the marbles with clay (help to prevent from bouncing); rearrange objects (e.g. moving windmill to the front of the slope, which increase the chance that it will be hit by the clay and hit the next object), and add in new creation (zig zag board) to increase time in a logical manner.

Photographic Evidences:



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