KIS Design Cycle Challenge (DCC)

Members:

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G8	- Poom	G10	- Na		

Research

A Rube Goldberg machine is a machine that causes a series of chain reactions, which involves materials such as pulleys, springs, dominoes and other common objects. The Rube Goldberg machine was first created by a man called Reuben Lucius "Rube" Goldberg, an engineer, inventor and cartoonist in 1942 in New York in the form of a cartoon known as the "Automatic Hitler-Kicking Machine". Reuben Goldberg created many machines before the Rube Goldberg machine and would used birds, monkeys, springs, pulleys, feathers, fingers, rockets, and other tools. These odd objects he created the machine with attracted the attention of many people around the world.

Potential energy : Potential energy is the energy stored in a certain object due to the poisition of the object or the arrangement. It is measured in joules and correlates closely to kinetic energy (law of energy conservation)

Kinetic energy : The energy a certain objects have relative to it's motion. It relates closely to acceleration and mass of the object.

Pulley : To use a pulley efficiently, one must first balance the 2 sides of the object, if the object is heavier on one side - it will go down and if it is light it will go up.

Boyle, Joseph J., and Douglas C. Giancoli. Upper Saddle River, NJ: Prentice Hall, 1998. Print.

Kalra, Pranav. "How to Use a Pulley Efficiently?" Personal interview. 12 Nov. 2013.

OK Go. *This Too Shall Pass*. 2010. MP3.

"Rube Goldberg." *Wikipedia*. Wikimedia Foundation, 13 Nov. 2013. Web. 15 Nov. 2013. <http://en.wikipedia.org/wiki/Rube_Goldberg>.

"The Story of Kinetic and Potential Energy." *YouTube*. YouTube, 04 Aug. 2009. Web. 15 Nov. 2013. <http://www.youtube.com/watch?v=7K4V0NvUxRg>.

Design brief

For this year's design cycle challenge, we have to create a rube goldberg machine which is a machines that causes chain reaction made from different types of common material and the use of dominoes. There are a set of specifications given to us at the beginning which includes: no external energy can be used (Water, Electricity, etc.), it must start and end with dominoes, there must be 3 actions and 2 potential energy, the goldburg machine must be related to the theme (given picture) and lastly, the machine must be set in a confined area (the taped square). Other than these specifications given in the beginning we also had to create our own which can be seen in the area below.

Design Specifications

- We will use levers
- We will use Inclined Plane
- We will use pulley
- There must be the use of more than 20 dominoes
- The ball must run on "wooden stick" ramp at some point
- There must be action on the top of the stage block

Design

Design : We have created a total of 3 designs for our Rube Goldberg machine; all the designs were realistic and achievable within the given time frame. The designs are very rough and the drawings are hard to understand so here is a summary of the actions in the different designs.

Design 1 :

1. Start off with dominoes on the floor
    a. The last domino is stuck to a string (lock mech) which would trigger the ball to move on top of the stage block - the ball will move on a wooden stick ramp
2. The ball would fall down from the stage block into a cup (pulley)
3. The cup with the ball would move-down to the floor and hit dominoes which would lead to the end

Design 2 :

1. Start off with dominoes on the floor
    a. Build a ascending staircase using the science textbooks provided - some steps might need 2 or 3 dominoes stacked together vertically to reach step height
2. Let make the domino trigger a lock mech that will release a ball
3. The ball will go down a stick ramp and make a u-turn (another contraption)
4. The ball will pull a pulley which would unlock another lock mech and would release a ball which would flow and trigger the start of the next group

Design 3 :

1. Start off with dominoes on the floor
2. The dominoes will trigger 3 balls which will run in different paths
    a. Path 1 : Run up a stack of books where a lock mech that controls a pulley (cups on the other side) as soon as the cup fall it will trigger more dominoes
    b. Path 2 : Trigger another ball to move (placed on a ramp up on the stage block) to move - the block will then drop down and hit more dominoes
    c. Path 3 : We will design a catapult that will shoot the dominoes across our area to hit more dominoes
3. The 3 paths of dominoes will collide at the end and trigger the start of the next group

Final Decision :

All these 3 designs clearly meet all of our design specifications as well as the ones given to us. However, we as a group decided to chose “Design 2” as our final design. The main reason is the fact that given the amount of time we have, Design 2 is appropriately challenging but it will leave us enough time to make fixes and edits. Whereas in Design 1, it is not challenging enough and would leave us too much time to wander around and in Design 3, which is too hard, would require too much time to set up and there are too many mechanisms which can leave space for more mistakes.

Na, the 10th grader in our group, told the whole group that he would prefer a simpler goldberg machine that works consistently than a really complicated on that doesn’t flow and requires a lot of touching. Furthermore, he told the group that we should keep it simple first incase there are problems, we would have time to fix it but if we don’t we can still add cooler contraptions to it.

Finding solutions

Although our machine was simple compared to other team's machine, we also had a lot of problems where we need to work as a team and find the best solution.

U-turn

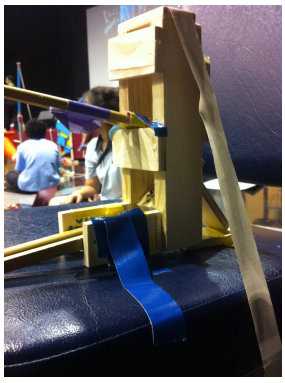
Initially, North create a contraption that causes the ball to go in the opposite direction, it was basically a wooden plank with future board curved around it. This idea worked! However, it wasn't consistent at all as different parts were unleved on the chair. Therefore, we developed something much more consistent, "a 2 floor type u-turn" seen below.

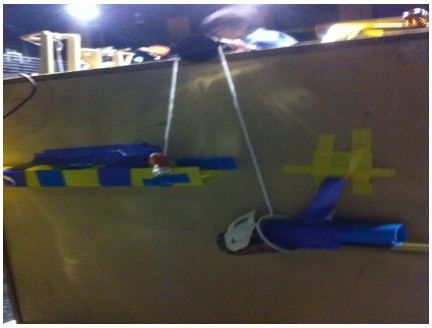
Dominoes -> Ball (lock)

Initially, this wasn't a lock type system, it was just simply; dominoes hit ball, ball moves. However, this method was not consistent at all as sometimes the domino will hit the ball right on top (not the side) so the ball doesn't move. We change this so that the ball "wants to" moves but put a large stick to block the movement, the lock is kind of like a see-saw where when the domino (large plank) falls over on the other side so the stick moves and the ball runs.

Pulley

The pulley was one of the hardest things to do as we have to find a way to set it up and use it in our machine. At first the pulley was supposed to carry a ball to the other side but we found out that it is way too complicated and hard so we changed so that the pulley triggers a lock that will let the ball free.





Relationship to given picture (Wires) :

We did neither used real wires nor decorated our machine to look like wires. This is because we didn't want to be like most of the groups who just took the "literal" appearance and used it. When we first received the pictures we did a small brainstorm of the properties of wires and decided that the properties we want to portray are: thin, slim, colorful and fast-rapid. Thin, slim and colorful are the physical properties of the wires and fast-rapid is the conceptual properties that wires can transport things really fast - internet to electricity.

We portray the thin and slim part through the use of various strings in our contraption. However, the biggest point is through the use of "thin" wooden sticks as ramps which is unique to our group. Although, using wooden sticks as ramps is much harder (twist or spacing) but we did it anyways as it reflected the property. As for the colorfulness, we did this by using various color of tapes (red, green, yellow, purple - all of which colors of wires)

As for the conceptual property, our machine takes very little time to go through everything (ball runs fast, dominoes falls rapidly) and furthermore, our machine is very simplistic - just like how wires work.

Evaluation

In the beginning we neglected all the design specifications and theme and each member just designed the coolest thing they could possibly think of. However, we soon realized that this doesn't work and we had to collaborate and make a good and reasonable plan. We sat together as a group created 3 designs and voted on the one we think is best.

To test if our designs work we came up with test, for many of the the specs it was easy as it was simple.

Test for each design spec

- **We will use levers ->** we can see that the lever method has been utilized in the lock system (domino hits one side, opens up path for ball)
- **We will use Inclined Plane ->** we can see that the thin stick ramp is tilted so that the ball can move downwards
- **We will use pulley ->** we used a pulley to open up locks
- **There must be the use of more than 20 dominoes ->** we certainly used more than 20 as each step, we used around 7 and we had 4 steps which would equal to 28 dominoes.
- **The ball must run on "wooden stick" ramp at some point ->** we used a wooden stick ramp and this can be verified by all members of the team
- **There must be action on the top of the stage block ->** the action on top of the stage block was the lock mech that utilized levers

The development of ideas can be seen in the "finding solution" stage as well as the daily videos in the link : http://kisdcc2013.weebly.com/team-31.html

Despite the fact that our machine ran flawlessly many times during the whole school run, there are still adjustments to be made, both big and small. The big things is that we should make our machine more complicated as we feel that this is not challenging enough. Furthermore, we would like the machine to connect to the theme more in the "appearance" part - as we spent most of our time developing mechanism and ignoring the appearance. However, the biggest improvement is "teamwork", we would like to share workload so that it is fairer (still considering grade level of course) as most of the work in this group is done by few individuals and sometimes some members do not commit to the group as much as they should.