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STEAM CHALLENGE

# Design a Rube Goldberg Machine


## Steam Project Challenge

Science Foundation Ireland sfi For what's next

DCU Ollscoil Chathair Bhaile Átha Cliath Dublin City University

CASTeL Centre for the Advancement of STEM Teaching and Learning

## WHO WAS RUBE GOLDBERG ?

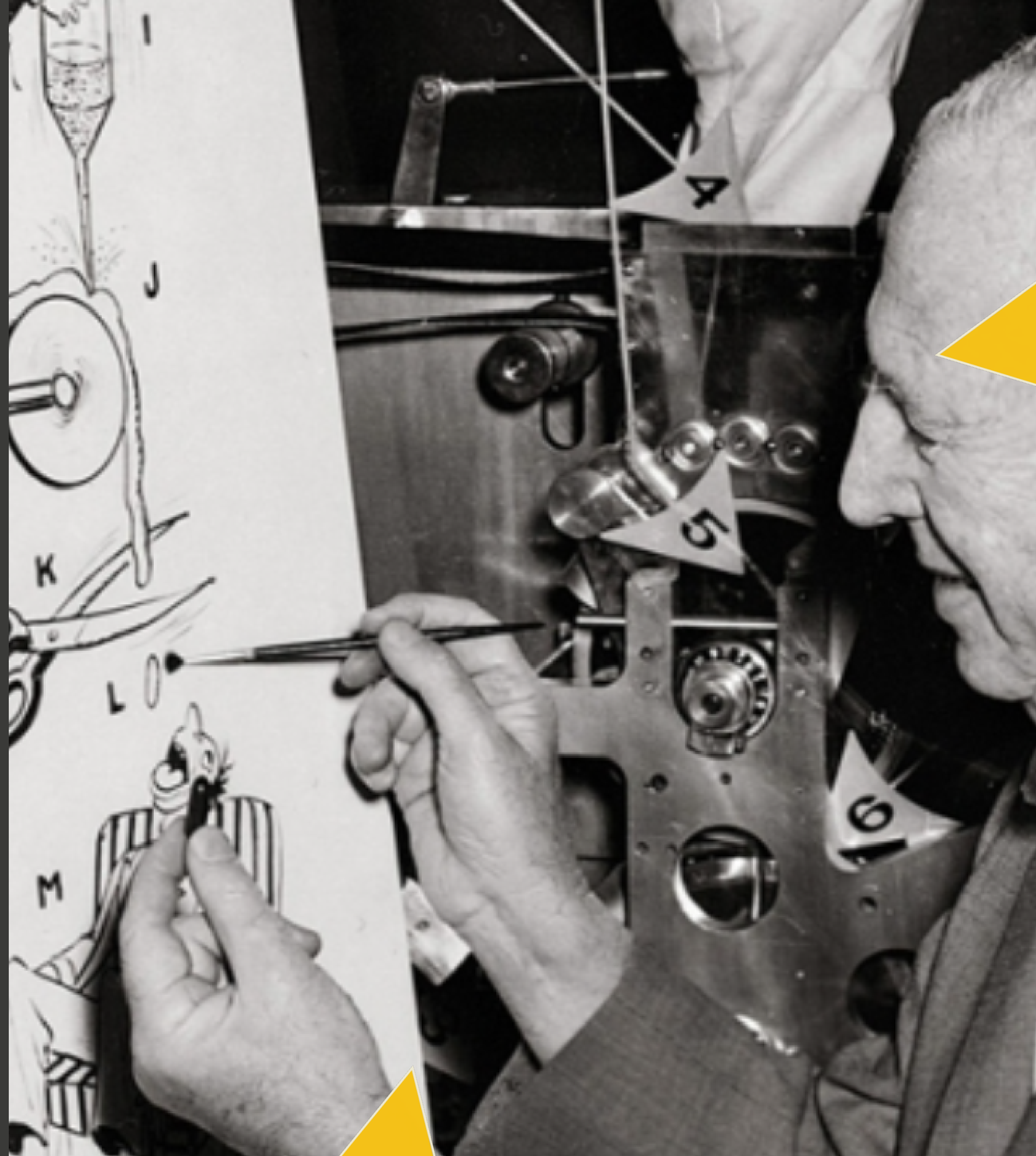
Rube Goldberg was a fascinating man. He was a cartoonist, a sculptor, an author, an engineer, an inventor, and the only person ever to be listed in Merriam-Webster's Dictionary as an adjective!

Goldberg was born in San Francisco in 1883 and began tracing illustrations when he was only four years old. He took his only drawing lessons with a local sign painter! Rube's father persuaded him to pursue a career in engineering and in 1904 he graduated with a engineering degree from the University of California, Berkeley. Goldberg's first job was as an engineer with San Francisco's Water and Sewers Department. He resigned after only six months and joined the San Francisco Chronicle newspaper as a sports cartoonist.

Goldberg moved across America to work with the New York Evening Mail where he he used his engineering experience to begin his 'invention cartoons'.

These cartoons detailed the zany contraptions of Goldberg's fictitious character' Professor Butts'.

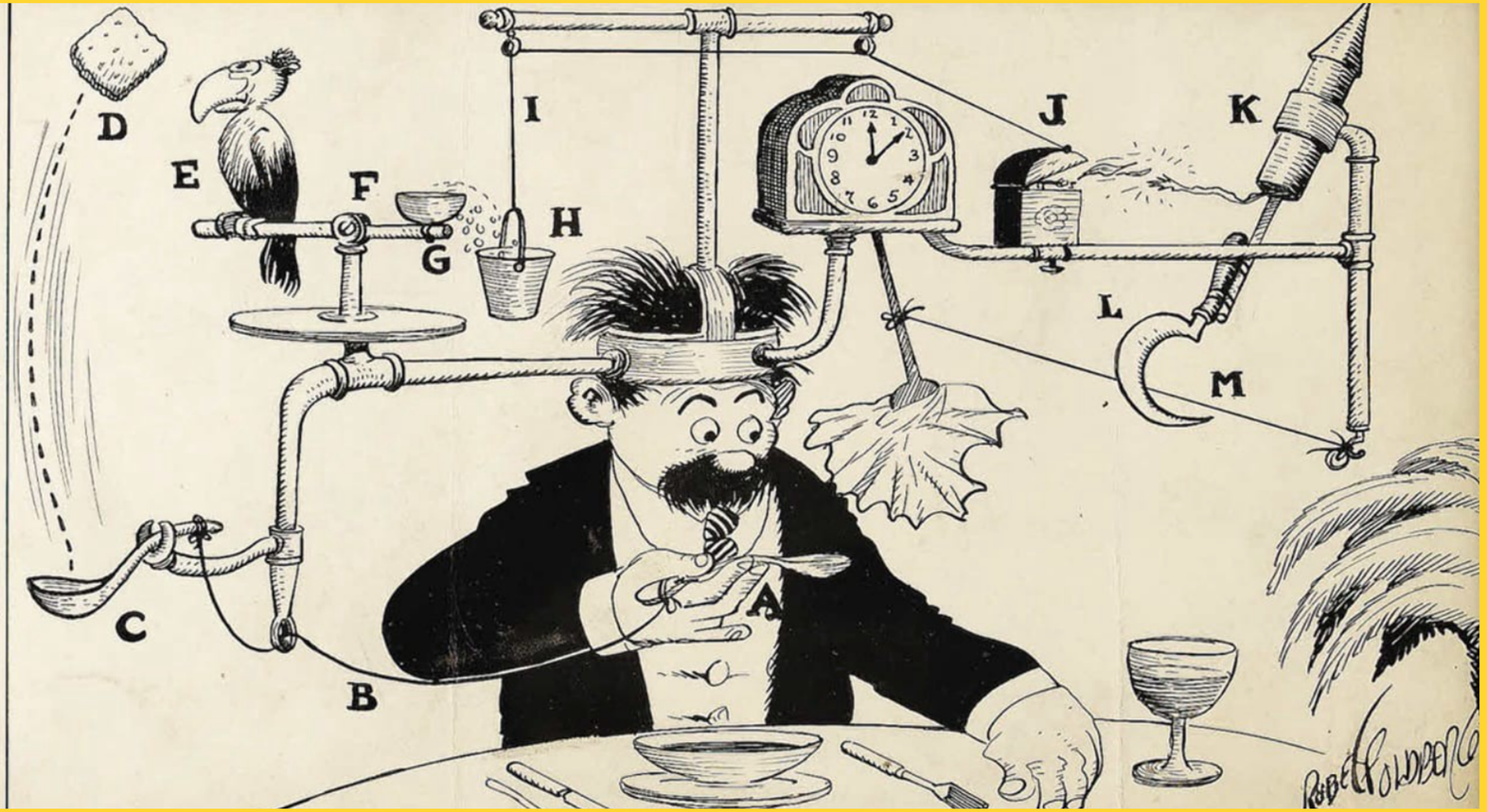
The illustrations became extremely famous and Professor Butt's contraptions became known as 'Rube Goldberg Machines'. They used 'chain reactions' to solve simple tasks in the most overcomplicated, inefficient, and hilarious ways possible. Rube Goldberg's name still lives on in pop culture . Movie scenes, websites, toys, books, art exhibitions and engineering competitions celebrate his inventions around the world everyday.



PROFESSOR BUTTS WALKS IN HIS SLEEP, STROLLS THROUGH A CACTUS FIELD IN HIS BARE FEET, AND SCREAMS OUT AN IDEA FOR A SELF-OPERATING NAPKIN.

AS YOU RAISE SPOON OF SOUP (A) TO YOUR MOUTH IT PULLS STRING (B), THEREBY JERKING LADLE (C) WHICH THROWS CRACKER (D) PAST PARROT (E). PARROT JUMPS AFTER CRACKER AND PERCH (F) TILTS, UPSETTING SEEDS (G) INTO PAIL (H). EXTRA WEIGHT IN PAIL PULLS CORD (I) WHICH OPENS AND LIGHTS AUTOMATIC CIGAR LIGHTER (J), SETTING OFF SKY-ROCKET (K) WHICH CAUSES SICKLE (L) TO CUT STRING (M) AND ALLOW PENDULUM WITH ATTACHED NAPKIN TO SWING BACK AND FORTH THEREBY WIPING OFF YOUR CHIN.

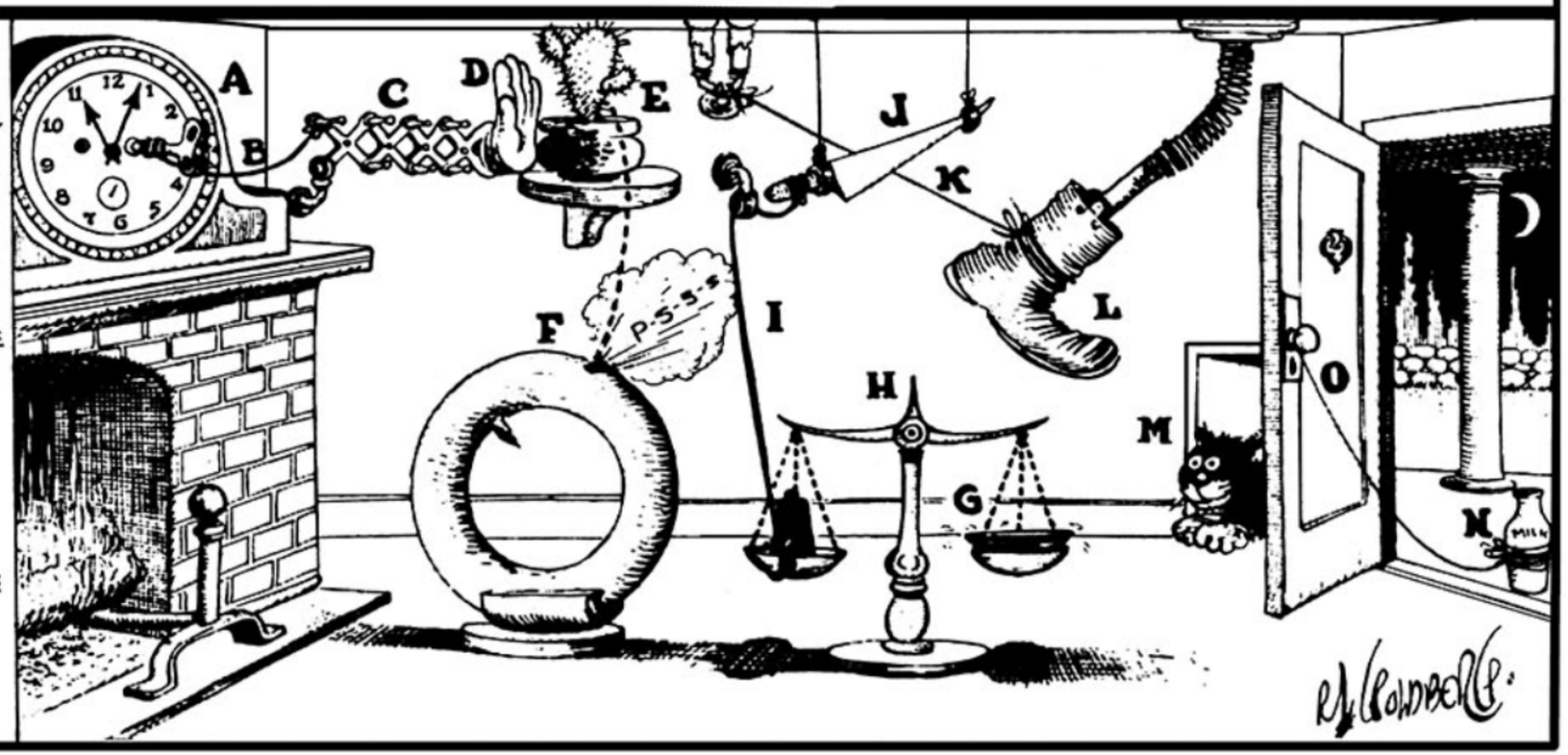
AFTER THE MEAL, SUBSTITUTE A HARMONICA FOR THE NAPKIN AND YOU'LL BE ABLE TO ENTERTAIN THE GUESTS WITH A LITTLE MUSIC.




GOLDBERG'S PROFESSOR BUTTS' SELF-OPERATING NAPKIN

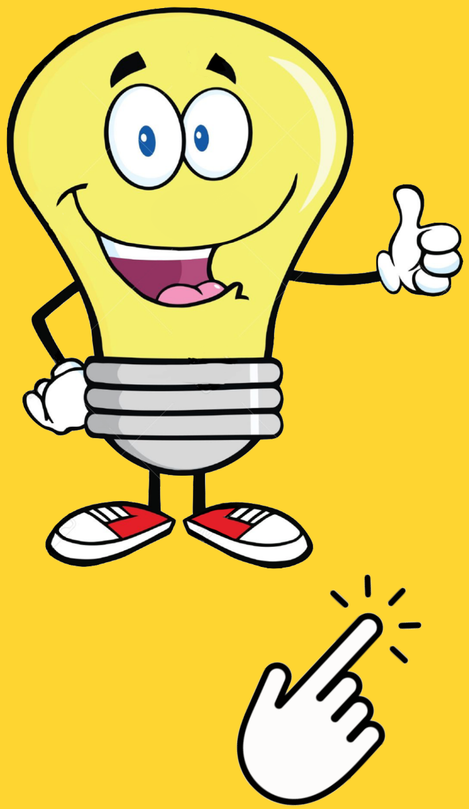
# Putting the Cat Out At Night by Rube Goldberg

PROFESSOR BUTTS TRIES TO PLAY THE XYLOPHONE WITH TWO STICKS OF DYNAMITE AND WHEN HE IS PICKED UP THREE MILES AWAY HE MUMBLES INCOHERENTLY ABOUT A SIMPLE IDEA FOR PUTTING THE CAT OUT AT NIGHT. AS YOU WIND CLOCK(A) IT TIGHTENS STRING (B) CAUSING IT TO EXTEND COLLAPSIBLE HATRACK (C). GLOVE(D) PUSHES CACTUS PLANT (E) FROM SHELF. CACTUS NEEDLE PUNCTURES INNER-TUBE (F) CAUSING HISSING SOUND WHICH CAT MISTAKES FOR SOMEONE CALLING. AS CAT APPROACHES SHE DISCOVERS SAUCER OF MILK(G) STANDING ON SCALE(H) AND AS SHE DRINKS MILK WEIGHT BECOMES LIGHTER, CAUSING SCALE TO PULL CORD(I) AND DRAW KNIFE(J) ACROSS STRING(K) RELEASING BOOT(L) WHICH PUSHES CAT OUT THE DOOR. AS CAT IS PUSHED OUT SHE UPSETS MILK BOTTLE(N) WHICH ROLLS AND PULLS CORD(O) CLOSING DOOR. IF BOOT MISSES CAT, THEN PUT BOOT ON RIGHT FOOT AND KICK THE CAT OUT YOURSELF.




PUTTING THE CAT OUT AT NIGHT

The website rubegoldberg.com contains more interesting biographical notes on the life of Rube. It also includes a video section called 'Rube-Tube' where videos of modern Rube Goldberg machines have been uploaded. Click the image below to enter the site and inspire your pupils!



RUBE GOLDBERG™

The world of hilarious invention!

www.rubegoldberg.com

Joseph Herscher is a YouTube personality known for his youtube channel 'Joseph's Machines'. Herscher is a New York based artist who specializes in making comical chain-reaction machines inspired by the work of Rube Goldberg. Check out two of his inventions 'The Page Turner' and 'The Dresser'.

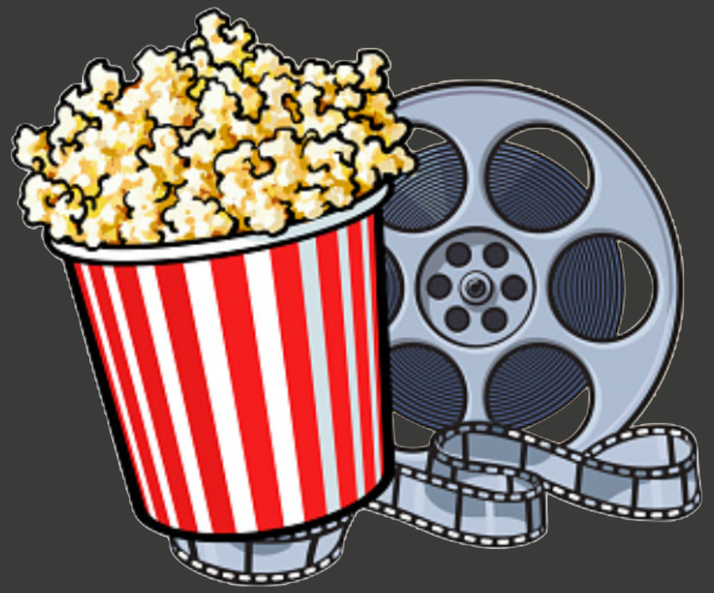
JOSEPH'S MACHINES

The Page Turner

The Dresser

'OK Go' are an American Rock Band based in Chicago. They are known for their often quirky and elaborate one-take music videos. Some are based on Goldberg's Chain Reaction Machines such as their 2010 release 'This Too Shall Pass' - Check out their hit song and spot the 'Goldberg influence on the video link below...

**Ok Go - This Too Shall Pass (2010)**



# Rube Goldberg in the Movies !

Rube Goldberg's 'chain reaction' machines have often featured in many of our favourite movies. From Wallace and Gromit to Home Alone to the Goonies and Chitty Chitty Bang Bang ! Perhaps the pupils can remember some of these examples ?!

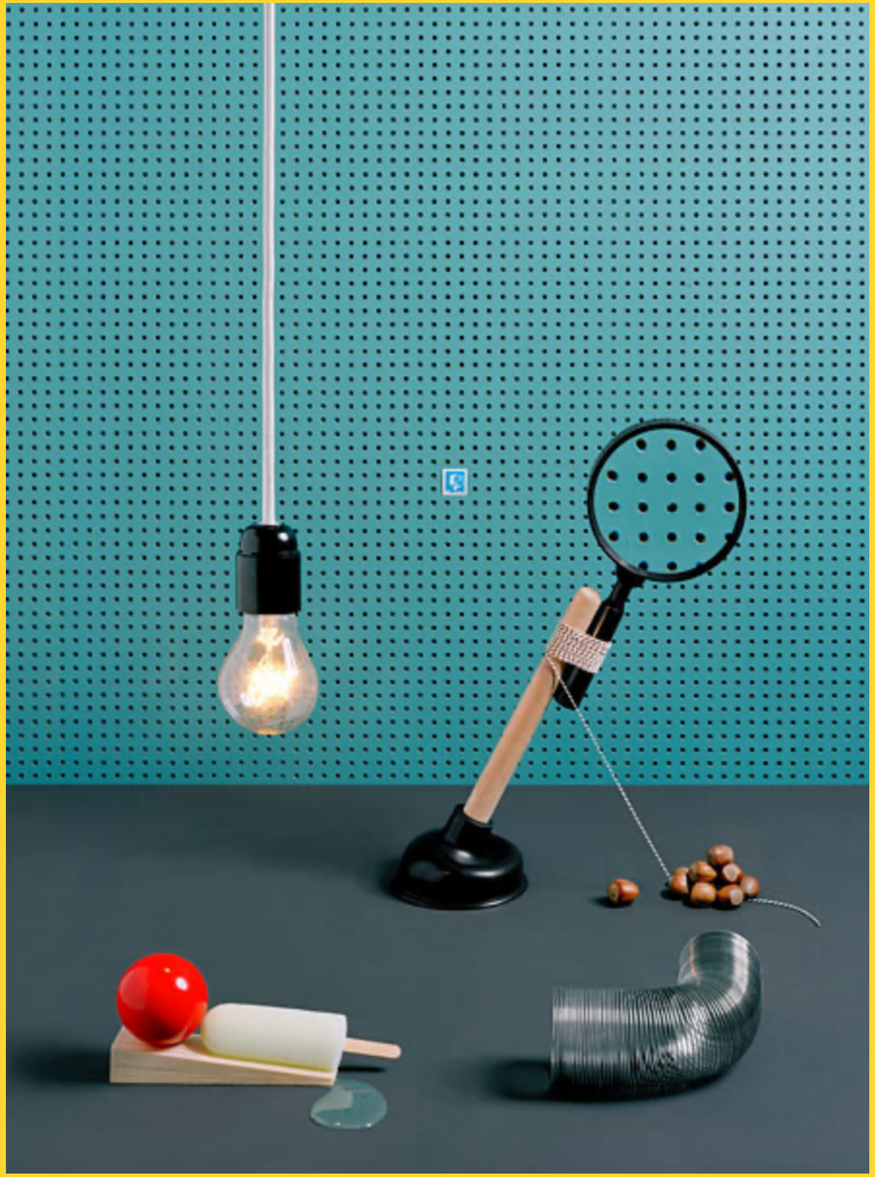
This ten minute Youtube clip lists top The Ten Rube Goldberg Machines in Movies!

Click here

# Your turn !!

Ask the children how they might enlarge the stamp?

What will set the snooker ball rolling?



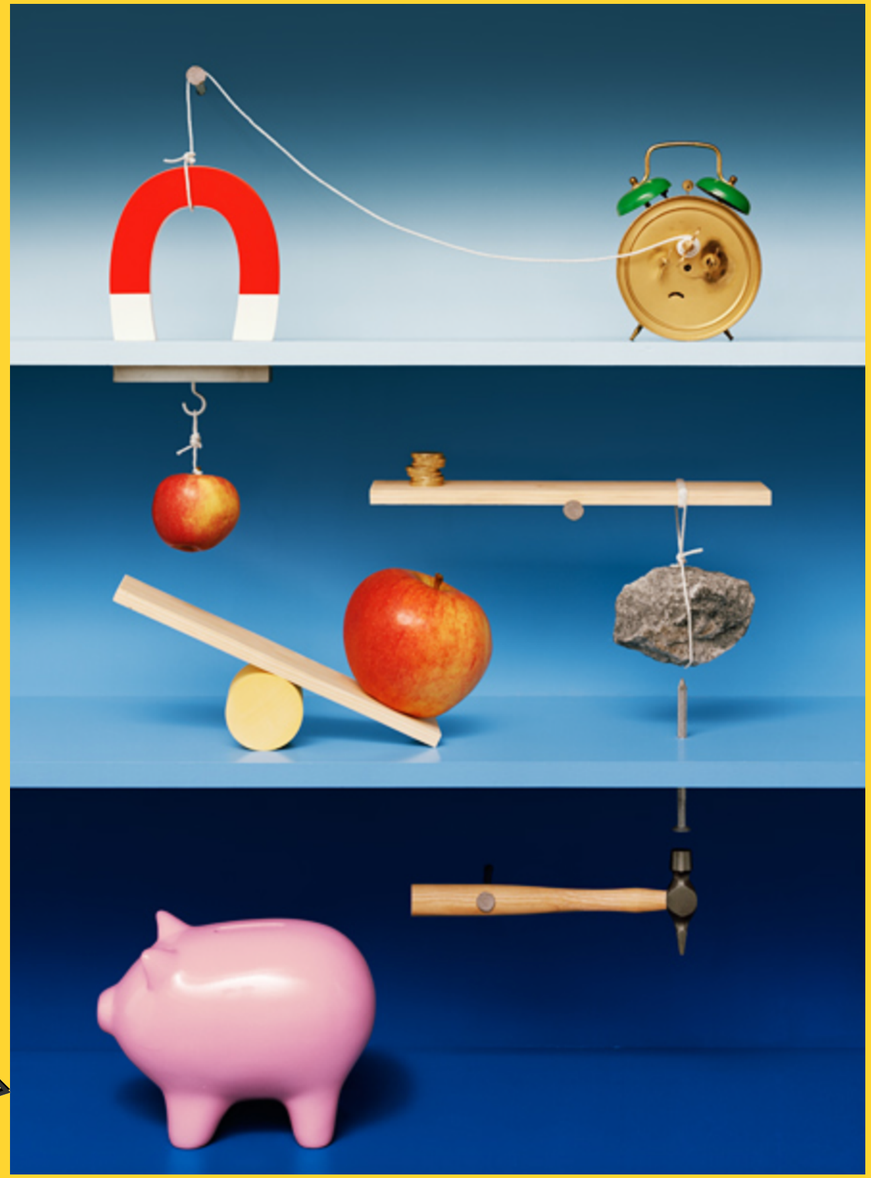
What will the slinky spring do?

Why do you think a rubber plunger is used?

Warm Up 1: Observe and discuss with your class what might happen in the picture above...

What needs to happen to break open the piggy-bank?

How might it be possible to get the nail to move down and move the hammer?



What is holding the higher apple in place?

How will it be possible to get that apple to fall?

When that apple falls, what will happen next?

Warm Up 2: Observe and discuss with your class what might happen in the picture above...

# Warm Up 3

Using some items in your classroom (perhaps some dominoes, a model car or a marble, a cardboard tube or ramp) , can you create a simple chain reaction machine?

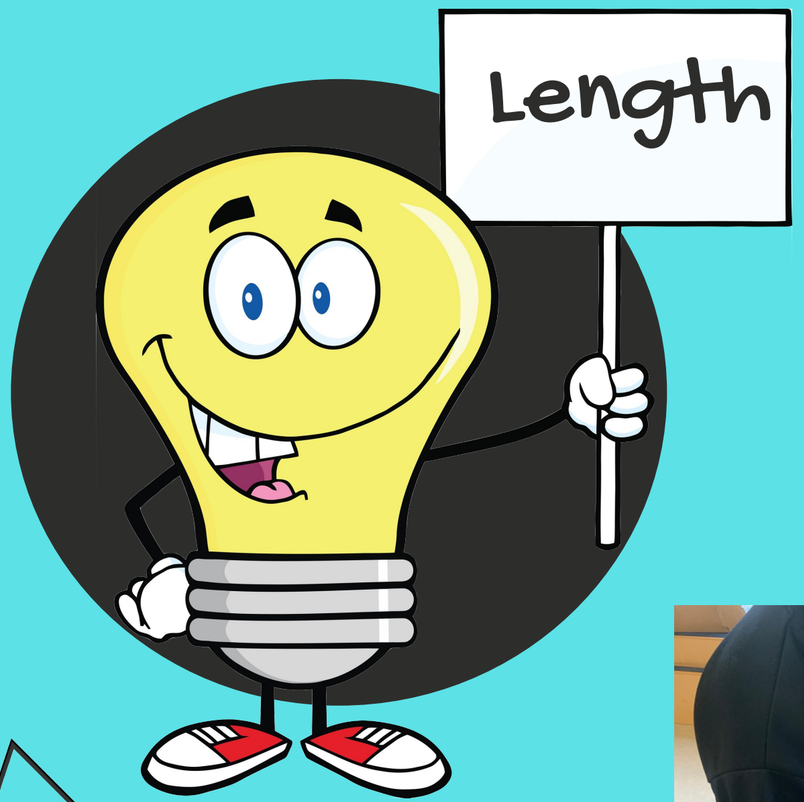

# Challenge Details

- Choosing from and using only the items listed on the next page can your group design and create a 'Rube Goldberg' Machine?
- The machine route must end with a marble dropping into a paper cup (Note: The marble does not necessarily have to take part in any other part of the machine route)
- The route must be at least 1 metre in length.
- The route must have at least one turn of over 45 degrees.
- Be as creative as you can and upload a Youtube video of your Goldberg machine when complete - directions on how to do this are included at the end of this presentation.

# Materials list

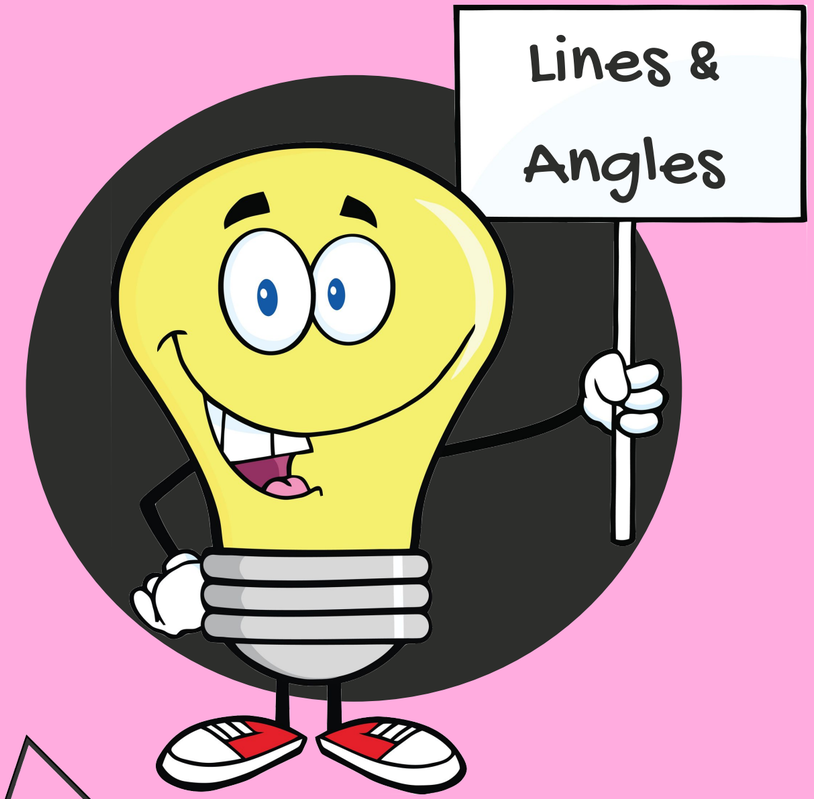
- 1 marble
- 1 paper cup
- no more than 40 Dominoes
- 2 cylinders (e.g - empty bean tin)
- 1 large cardboard box
- 6 A4 Sheets of cards
- 1 roll of masking tape
- 2 toy model cars
- 2 classroom tables
- 1 roll of string
- 1 newspaper
- no more than 150g of plasticine
- A Hammer
- 1 metre of tin foil
- 6 nails
- 1 block of timber
- 2 magnets
- a golfball
- 2 spoons

## Opportunities for Maths



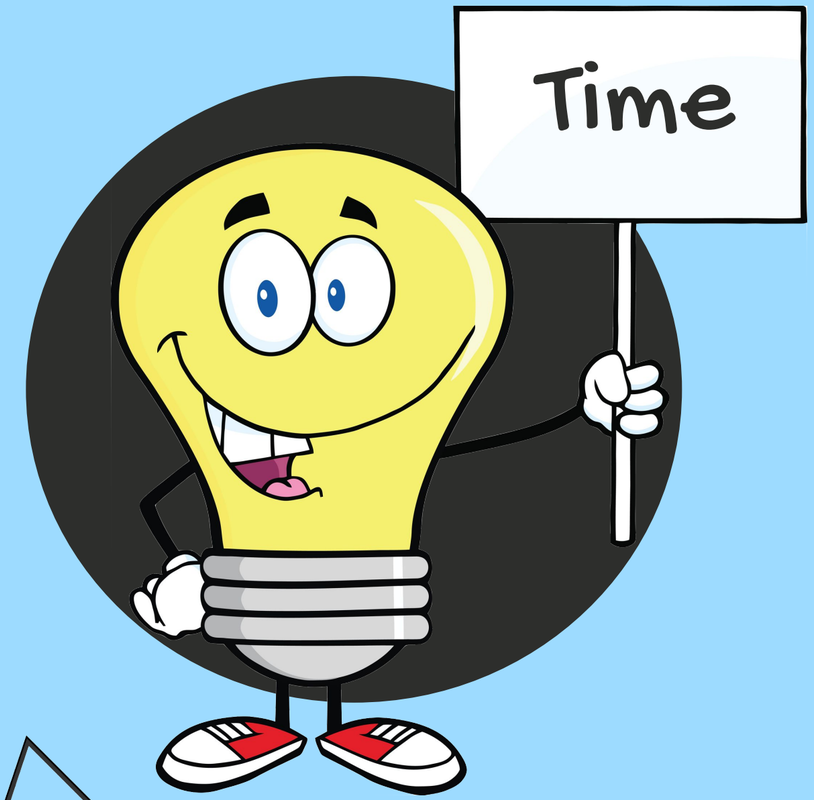

- Can you build your Goldberg Machine route to a specific length? i.e 2m.
- Who can build the longest Goldberg machine ? How do we measure it if it is not built in a straight line? (string)
- Maybe add in some 'Marble Drops'! - Create a 20cm marble/golf ball fall.
- What about a marble jump? Can your group build a ramp or a jump in their machine that propels a marble or the golfball across a gap. How far can you make your marble jump?

# Opportunities for Maths

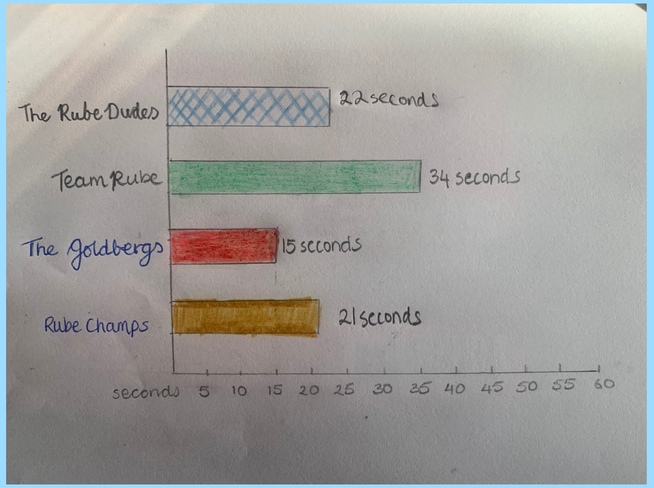



- Can your Goldberg machine include bends or ramps with specific angles?i.e 45 degrees.
- Are your group able to spot the relationship between your angles and the speed of your machine or how far your marble/golf ball jumps?
- Can you show these comparisons in a data chart? Which chart is most suitable?

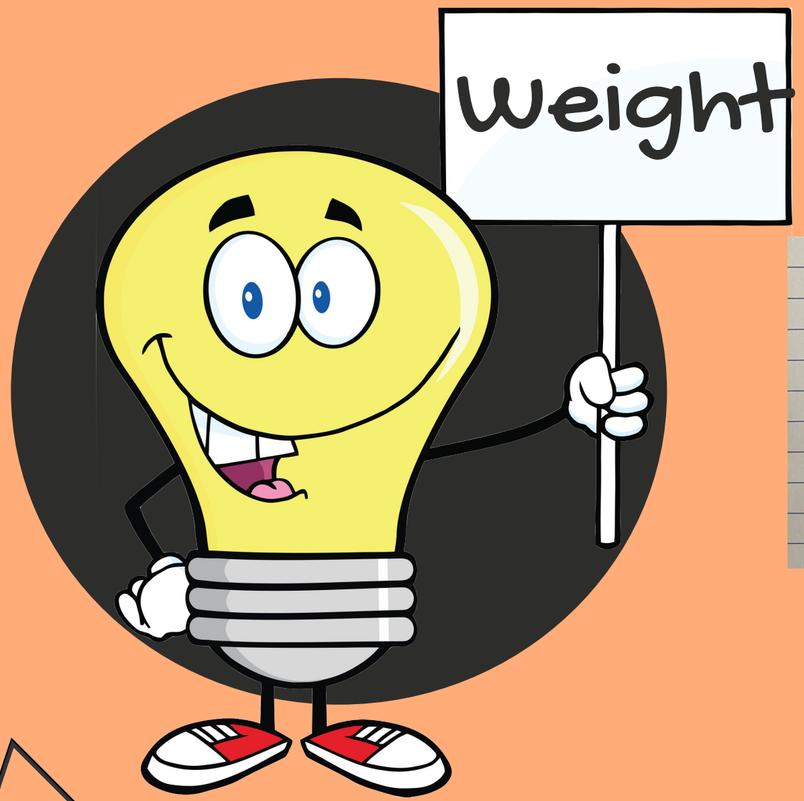
# Opportunities for Maths



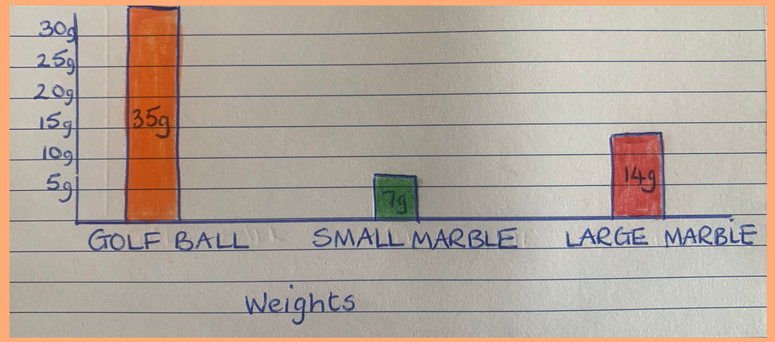

- Can you design and build your Goldberg machine to stay in motion from start to finish for a specific time? i.e 30 seconds - What will you modify if your machine is too slow/quick?
- Which group can build the longest running Goldberg Machine? Time each effort. What is the average time?
- Create a data chart detailing each group's time.

# Opportunities for Maths




- When creating the 'materials list' include some portions as weights. ( 150 g of plasticine, a can weighing less than 300g etc. ) The pupils can weigh out their own materials .

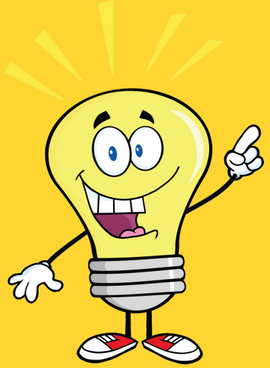



DISTANCE TRAVELLED

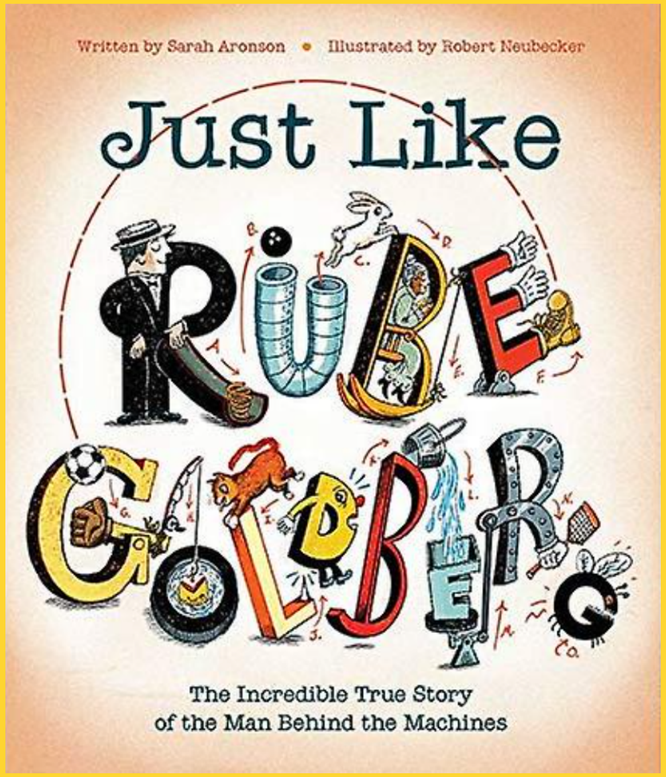
| | ROLL 1 | ROLL 2 | ROLL 3 |
|---|---|---|---|
| LARGE MARBLE | 22cm | 27cm | 24cm |
| SMALL MARBLE | 11cm | 13cm | 11cm |
| GOLF BALL | 22cm | 26cm | 26cm |

# Directions on how to Upload your Youtube video..

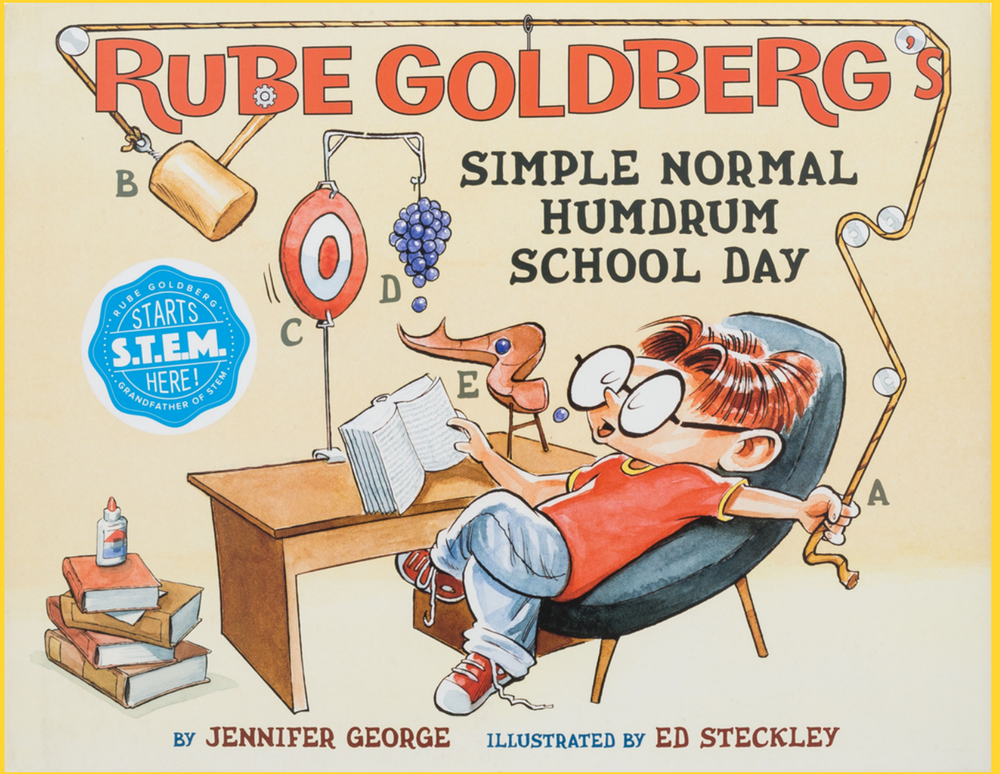
1. Create Google Gmail account
2. Click into the following link: https://www.youtube.com/ to upload video content.
3. Sign into account on the right top of your screen
4. Click on Camera + icon on top right of screen
5. Upload Video
6. Select file
   a. For visibility select unlisted
7. Publish now.
8. Add relevant Title with your school name.
9. Select for Audience
10. Click on blue Upload Button.
11. Tweet your YouTube link on your school's twitter and tag @maths4all



# Opportunities to integrate this Challenge with Literacy…




Just Like Rube Goldberg by Sarah Aronson .




Rube Goldberg's Simple Normal Humdrum School Day by Jennifer George .

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## Lesson Developed by Aaron Carroll

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