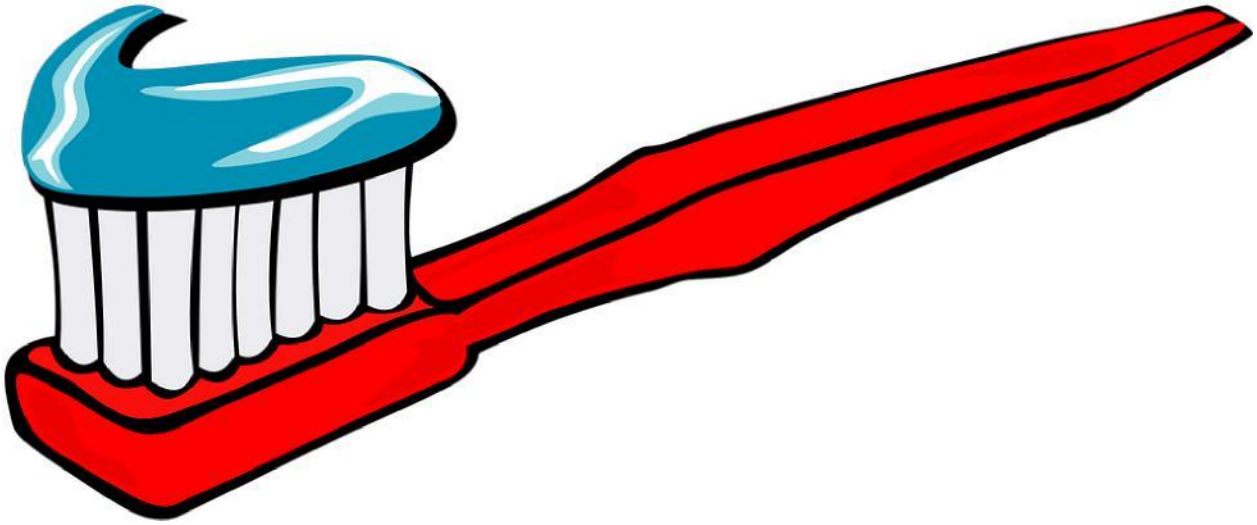
Engineering and Design Challenge
2018 Rube Goldberg

Put toothpaste on a toothbrush.



A STEM CHALLENGE FOR YOUTH 3rd THROUGH 12th GRADES AND ADULTS

Ransom County Fair – August 26, 2018

11:00 a.m. – Expo Center West Wing

This Challenge

The first Rube Goldberg challenge is to design and build a Rube Goldberg contraption (RG) that squeezes toothpaste out of a toothpaste tube and on to a toothbrush. The toothbrush should be a standard adult size (~19 cm) and the toothpaste tube should be 6 oz. You must also make sure your machine meets specifications listed on the following pages.

Mission

The goal of Rube Goldberg is to encourage critical thinking, creativity, innovation, and problem solving in a non-traditional learning even and to have FUN in the process. Youth who have completed third through twelfth grades and beyond can compete in the Rube Goldberg Challenge. Youth will use their STEM knowledge and skills to solve problems, make a plan, and design a solution.

Rube Goldberg (1883-1970) was a Pulitzer Prize-winning cartoonist who was best known for the wacky inventions that appeared in his comics. His cartoons appeared in newspapers for more than 50 years.

A RG is an overly complex contraption that does a simple task. The RG contraption uses everyday items in a series of chain-reaction steps that accomplish a task. Rube Goldberg allows youth to use physics, engineering, humor, and storytelling. Teams are encouraged to create a theme for their RG and incorporate their theme in the contraption.

Teams that build a RG and complete the recordkeeping journal and a poster summarizing their work can compete or display their work at their county fair.

Who Can Be On A Rube Goldberg Team?

- A team must have at least 3 youth team members, but no more than 6.
- Youth who will have completed 3rd through 12th grades by the end of the 2017-2018 school year are eligible to be on a RG team. There will be a junior and senior contest. Individuals who have completed any grade beyond twelfth are eligible to be on an adult RG team.
- The junior age group is 8 years- 12 years; the senior age group is 13 years- 18 years.
- In addition to the 3-6 youth, each team must have at least one adult volunteer leader.
- RG contest is open to anyone. You do not need to be involved in 4-H to be on a team.

Registration

A. Team sign-up- This sign up serves as a notice that you have signed up as an RG team. **Sign up can be done by contacting the Ransom County Extension office at 701-683-6128 by <u>August 10</u>. When registering you will need to provide a full team roster including age, grade and the coach for the team and contact information.**

RG Specifications

Machine Specification	Requirements or Limitations
Complete the official task (put toothpaste on a toothbrush)	Required
Safe for participants and observers	Required
Written list of all steps in your RG	Required
Number of steps	Minimum: 10 Maximum: unlimited
Physical size of RG	Minimum: no minimum size Maximum: 6 feet x 6 feet x 6 feet
Single run time to complete the task	Minimum: None Maximum: 2
Reset time (time required to set your machine up again after a run)	Maximum: 20 minutes
Air compressor hoses running to the machine	Maximum 1 hose
AC or DC power cords running to the machine	Maximum 1 cord
Air compressor hoses and power cords used within the machine boundaries	Unlimited
Objects flying beyond machine boundaries	Objects must stay within overall maximum boundary of 6 feet x 6 feet x 6 feet.
Corporate logos	Allowed with written permission from the logo owner.
Use of live animals	Not allowed
Hazardous (toxic, noxious, dangerous) materials, explosives, or flames.	Not allowed
Combustion engines	Not allowed (No gasoline or other combustible fluid may be a part of the machine.)
Use of profane, indecent, or lewd expressions, offensive symbols or graphics	Not allowed

Theme and Story

While developing the design for your machine, consider having a theme for your machine. The theme and story should be a fun part of creating your machine, and might even make the design process easier. As a team, decide how you will share your story. Your team will have a chance to tell the audiences and judges about your RG machine story and theme. Videos should not be used as a presentation technique during the contest.

Recordkeeping Materials

One of the most important parts of the Rub Goldberg challenge is reflecting on and recording one's learning as the team designs the RG machine. Each team should have a notebook (journal) documenting the design and building process. The team should also prepare a presentation that summarizes their work outlined in the journal. The recordkeeping requirements must be completed by the time the RG machine is judged at the county fair. The completed notebook will be judged with the machine.

Team Notebook Specifics

The team notebook or journal should be a record of the team's ideas, progress, setbacks, and accomplishments throughout the design and building of the RG. The notebook should be accessible to all the team members and everyone should have the opportunity to make entries and record information. The notebook should contain both writings and drawings. If an idea is not used or if something does not work, do not scribble it out or erase the information. Instead, go into detail on why the idea did not work or wasn't used. The team can write in the notebook throughout their meeting or the team could designate the last 10-15 minutes of the meeting to write in the notebook.

Suggestions of what to record....the location, date, and length of time the team worked on the machine. Record who was present at each of the sessions; document each of the experiments. Explain if the experiment worked or did not work and why.

The purpose of the notebook is to give the team members a way to reflect on what they learned and accomplished each time they met. The notebook also provides documentation to the fair conference judges of the team's work, including research, successes, setbacks and progress. The following page illustrates the five stages of the design process and outlines some questions that may help the team record their meeting entries.

DESIGN PROCESS STAGES

The design process has five stages:

1. Problem definition
2. Information gathering
3. Idea generation
4. Testing and decision-making
5. Redesign

REFLECTING ON YOUR PROCESS

Problem definition:

- What is one problem that your team ran into today?

Information gathering:

- What did your team know already that helped you think of a solution?
- What more does your team need to know to help you think of a solution?
- How does your team plan to gather the information that you need?

Idea generation and decision-making:

- List the ideas that your team came up with for solving the problem.
- How did your team decide which of these ideas to test?

Testing:

- Did it work? If yes, how? If not, what more did your team do to solve the problem?
- Write down the information/date that your team collects from testing to help you make a decision/solve the problem.

Redesign:

- What did your team do to improve your design/or solve the problem?

SUMMARY PRESENTATION

The purpose of the summary is to assist the team in describing their experience during the conference judging at the fair. The summary can be a one or two page account that highlights the team's experience, or it can be a poster, photographs, a video or anything else the team could use to describe their experience. The journal helps the team think about the entire process in small steps, the summary highlights the big moments, the fun, and frustrations the team had from the beginning to end.

FREQUENTLY ASKED QUESTIONS ABOUT RG

Question: What is a step?

A step in the machine is a transfer of energy from one action to another action: identical transfers of energy in succession should be counted as 1 step.

Example: A sequence of dominos hitting each other counts as 1 step. Counting 100 dominoes as 100 steps is not a different transfer of energy.

Question: Can programmable logic controllers or microcontrollers be used?

Yes, but their use must fit within the definition of a step. Steps that use controllers should be clearly stated in the written step list and include detailed information on how the transfer of energy is accomplished.

Example: A ball falls onto a switch connected to a controller that turns on a motor.

Question: What is meant by human intervention?

Answer: Once the first step in your machine takes place, (a team member can physically start the machine) the machine should function all the way to the end without a person touching it. If the machine fails before it completes the task, it may be necessary to start it again from the point where it failed.

Question: Can I enter a machine that has been previously built and posted online?

Answer: No. All entries must be new machines created and built for entry into this competition.

Question: Does out machine have to fill the whole 6' x 6' x 6' space?

No, your machine can be smaller than the maximum allowed dimensions, it just can't be larger.

Question: Can you tell me more about the theme and the story?

This year's task is putting toothpaste on a toothbrush. You could select a theme that ties in with a situation in which you might be using a toothbrush/toothpaste. Once you think of your theme, the story will begin to take shape.

Question: What sources can we use for research?

You may already know some the information you use to build your RG before you start the design process. However, you probably won't know everything. You can use the library, your teachers, the Internet, your family or 4-H volunteers. It might be a good idea to talk to an engineer if you know one.

QUESTIONS ABOUT THIS YEAR'S CHALLENGE

Question: Does the size of the toothbrush or toothpaste tube matter?

Yes, the toothbrush should be a standard adult size toothbrush (~19cm), and the toothpaste should be the 6.0 OZ size.

Question: Is there a certain amount of toothpaste that needs to be squeezed onto the toothbrush?

No, as long as the toothpaste can be seen by the naked eye the amount does not matter.

QUESTIONS ABOUT RG TEAMS

Question: Can a team be made up of youth from different school grades?
Yes. A team can be made up of more than one grade, as long as all members are in the same age division.

EXHIBITING YOUR MACHINE AT COUNTY THE FAIR

Be sure to read the information in the registration section about registering to compete at your county fair.

Transporting And Storing Your Machine

Space differs from one county fair to the next. Teams must contact their county Extension staff regarding their plans to exhibit their machine at the county fair. The staff will be able to give you guidelines on whether or not you will be able to drive right up to the exhibit space at your county fair to unload your machine or whether or not it can be stored at the fairgrounds before or after the fair takes place.

Fair Judging

All entries will be judged using the conference judging process, where a team meets with the judges at the fair and talks with them about their machine, including developing the design, building it, solving problems, identifying lessons and their applications and working as a team. Final ribbon placement will be based 50% on the team members' knowledge of that process and 50% on the machine itself.
Ribbon placements will be purple, blue, red or white.

What The Ribbon Colors Mean

- **Purple**. The exhibit meets all standards. The exhibit meets all standards. The exhibitor has shown complete understanding of what, how, and why the exhibit was done, and has a thorough knowledge of the subject. The exhibit and workmanship are extraordinary and need no improvement.

- **Blue**. The exhibit meets most standards. The exhibitor can explain what, how, and why the exhibit was done and has a good knowledge of the subject. The exhibit is well organized and well done.

- **Red**. The exhibit meets some standards. The exhibitor can somewhat explain what, how, and why the exhibit was done and has a fair knowledge of the subject. Some improvements may be needed on the exhibit.

- White. The exhibit meets few standards and lacks the quality of other exhibits. The exhibitor cannot adequately explain the what, how and why of the exhibit. Possibly they have overlooked a safety flaw. Improvement is needed in either the exhibit, the knowledge of the subject, or both.

Judging Process

- The team will participate in a public presentation and conference-judging-style experience.
- Teams will share their journals during conference judging and review the process for the design and construction of their RG.
- Team members will share with the judge their individual contributions of the construction of the machine.
- The team will demonstrate its machine for the judge and the public.
- Teams that complete the judging process will be awarded a purple, blue, red or white ribbon at the county fair.

Rube Goldberg Judging Form

Date _____ Grade range of team members _____

County _____ Team Name _____

Number of team members at judging_____

___ Purple ___ Blue ___ Red ___ White	**Very Good**	**Some Improvement Needed**	**Much Improvement Needed**
Theme or story about the machine			
Sequences of steps are clear and described; energy transfer is described; simple machines are identified			
Degree of machine complexity			
Degree of innovation, creative use of everyday items in new ways			
Degree of human intervention			
Machine run time: Up to 2 minutes- very good 2-3 minutes- some improvement needed Over 3 minutes- much improvement needed			
Worked as a team, role of each team member is identified and described			
Discovered ways problems were solved and described using examples; demonstrates perseverance			

	Very Good	Some Improvement Needed	Much Improvement Needed
Identified “lessons” learned and how they apply beyond RG			
Conducted research (sought information and knowledge)			
Elements of the design process stages are evident			
Provided a record or journal that documents the process of building the RG			

Machine Specifications	Specifications met	Specifications not met
Number of Steps (≥10)		
Task completed		
Objects leaving the machine		
Machine does not exceed size requirement		
Machine meets rule and safety requirements		