Objectives
• Design and create a machine that will run self sustained for 30 – 60 seconds.
• Identify and apply different types of forces and motion
• Analyze and explain different types of forces and motion

Introduction
“A Rube Goldberg machine is a contraption, invention, device or apparatus that is deliberately over-engineered to perform a simple task in a complicated fashion, generally including a chain reaction. The expression is named after American cartoonist and inventor Rube Goldberg.”

Show students a video of Andrew Smith’s Moon Pool, part of the permanent collection and on display at the Springville Museum of Art. Ask them what they notice about the movement of the machine. What forces are causing the wheels to turn?

In order to apply the ideas of forces and motion found in engineering and simple machines, students will design and create a Rube Goldberg machine. Students will need to use each of the following types of force or motion including: Push, Pull, Pulley, Lever, Ramp, Gravity.

Materials
• Video of Andrew Smith’s Moon Pool
• Pulleys
• Marbles/Balls
• Wood
• Cardboard
• Rulers
• Tubes (Cardboard, PVC)
• Balloon
• Weights
• Toy Cars
• Rope/String
• Tape/ Glue
• Dominoes
• Cups

Images from the Museum
• Andrew Smith, Moon Pool

Utah Core Standards
1st Grade Science Standard 3
Objective 1c Explain how a push or pull can affect how an object moves.

2nd Grade Science Standard 3
Objective 1a Observe falling objects and identify things that prevent them from reaching the ground.

3rd Grade Science Standard 3
Objective 1
Demonstrate how forces cause changes in speed or direction of objects.
  a. Show that objects at rest will not move unless a force is applied to them.
  b. Compare the forces of pushing and pulling.
  c. Investigate how forces applied through simple machines affect the direction and/or amount of resulting force.

Visual Arts
Standard 3.V.CR.4: Individually or collaboratively construct representations, diagrams, or maps of places that are part of everyday life.

Standard 3.V.CR.1: Elaborate on an imaginative idea and apply knowledge of available resources, tools, and technologies to investigate personal ideas through the art-making process.

Standard 3.V.CR.2: Create a personally satisfying artwork using a variety of artistic processes and materials.
Introduction Cont.

“Rube Goldberg’s cartoons became well known for depicting complicated devices that performed simple tasks in indirect convoluted ways.”

After sufficient exploration, instruct students to select a design or combine design elements from the group to start working toward the decided task (e.g. popping a balloon). One obstacle is having space for students to build over time. Most likely, students will need more then one day or session to create a 30 – 60 second machine that completes the task.

Students can either work in a smaller, transportable space such as a box, or they can work in pieces and deconstruct and reconstruct at the beginning and end of each session.

Essential Questions:
• How do non-living things move?
• How can tools be used to make work easier?
• What is the relationship between forces and motion?
• What is the role of gravity in forces and motion?

Variations
If available, have students document their completed Rube Goldberg Machine using a camera.

Vocabulary Words
Horizontal and vertical force
Potential energy
Gravity acceleration due to gravity
Pulley
Levers
Friction
Wheels
Ramps
Ropes

Assessment
After students have created their one or two step machines, allow students to present their final machines to the class. If their machine isn’t successful, discuss what they could do differently next time. Discuss the important role of trial and error in engineering.

Resources
https://www.rubegoldberg.com/about/
Simple example rube goldberg machine videos on Youtube
Rube Goldberg Cartoons

Professor Butts walks in his sleep, strolls through a cactus field, 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 label (C), which throws cracker (D) past parrot (E). Parrot jumps after cracker and perches (F), tilts, upsetting seeds (G) into pan (H). Extra weight in pan pulls cord (I) which opens and lights automatic cigar lighter (J). Setting off sky rocket (K) which causes sickle (L) to cut strings (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.

The Inventions of Professor Luciter G. Butts, A.K.

By Rube Goldberg

The professor's brain-fuselage comes out of a tail bar with a new idea for removing gravy spots from vest:

You look through telescope (A) and see friend who appears so close that you reach out to shake hands, upsetting fish bowl (B) which breaks, causing foot pedal (C) to turn grind stone (D) sharpening ax (E). Flying sparks (F) awaken cat (G) who thinking they are bats and that night time has approached, he flies away pulling cord (H) which releases partition (I). In fly trap (J) allowing flies to reach vest (K), and eat off all the gravy spots.

If gravy spots on your vest happen to form a particularly attractive design, don't bother, about using apparatus at all. Let your friends think you are wearing a fancy vest.

Simple Alarm Clock

The early bird (A) arrives and catches worm (B), pulling string (C) and shooting off pistol (D). Bullet (E) busts balloon (F), dropping brick (G) on bulb (H) of atomizer (I) and shooting perfume (J) on sponge (K). As sponge gains weight, it lowers itself and pulls string (L), raising end of board (M). Cannon ball (N) drops on nose of sleeping gentleman. String tied to cannon ball releases cork (O) of vacuum bottle (P), and ice water falls on sleeper's face to assist the cannon ball in its good work.
Andrew Smith, *Moon Pool*, 2004