Digital Education Program: Rube Goldberg Machines

**Driving Question**
How do forces affect the way an object moves?

**Grade group**
All ages. The complexity of the machine will depend on the child’s ability

**Safety Considerations**
Parents should exercise caution with potentially dangerous materials such as scissors, heavy objects, matches, and anything that could be a choking hazard.

**Materials**
A small ball or marble (a paper ball will even work in a pinch!)
Various household and craft materials, including but not limited to:
- Paper towel and toilet paper tubes
- String
- Pipe cleaners
- Tape
- Paper or cardstock
- Aluminum foil
- Clothespins
- Dominoes
- Anything else you can think of or have laying around!

**Lesson Standard (5th Grade):**
- Construct an explanation using evidence to demonstrate that objects can affect other objects even when they are not touching. (5.P2U1.3)
- Obtain, analyze, and communicate evidence of the effects that balanced and unbalanced forces have on the motion of objects. (5.P3U1.4)
- Define problems and design solutions pertaining to force and motion. (5.P3U2.5)
- Analyze and interpret data to determine how and where energy is transferred when objects move. (5.P4U1.6)

**Vocabulary:**
- Force: an interaction between two objects
- Troubleshooting: finding the source of a problem in a large, complicated system. This makes it much easier to fix the problem!

**Lesson Objective:** Students will be able to describe the way forces (interactions between two objects) can affect the way an object moves. Students will also be able to predict where something will move based on the forces acting on it. Students will be able to use their knowledge of forces and motion to achieve a desired goal.
schedule:

day 1: the science challenge: rube goldberg machine begins! learn about rube goldberg machines by watching youtube videos of these machines at work and reading about the history of them.

day 2-3: sketch an idea of your rube goldberg machine, and plan how you will build it. begin gathering materials. share your plans with us through facebook or email!

day 4-6: continue building and testing your machine. if you still have more time to work on it, add an extra step and figure out how to modify your machine.

day 7: submit a picture or video of your final machine to our facebook or email threads.

instructions:

1. start with some inspiration! rube goldberg machines are meant to do an ordinary task, like turning on a light switch, in a very complicated way. with a parent’s help, look up videos on youtube of some rube goldberg machines. we have provided some in the resources below.

2. plan your machine. think about what your machine will do. throw a can in the recycling? feed the cat? water a plant? next, begin sketching the steps for how you will make that happen. it may help to work backward: start with the end goal and go towards the start.
   a. something important to keep in mind: for a rube goldberg machine, you should only touch one thing. that will set everything in motion, and everything after your first step should happen without you having to touch anything.

3. complete a sketch of your rube goldberg machine. include arrows to show how your ball, marble, or another object will move. make sure to share these with us at lowell observatory!

4. gather materials for building your machine. look at your plan, and ask a parent to help you collect the items you will need. you may not have everything - and that’s okay! part of being a scientist is being able to adapt.

5. begin constructing your machine. allow enough time to let things like glue dry. it may be helpful to see how only parts of your machine work at a time instead of seeing how the entire machine works. this is a very important skill called troubleshooting.

6. the first (or second, or third, or fiftieth) time you test it, your machine may not work. that is okay! find the problem, fix it, and try again.
7. Once your machine is completed, take a video of it in action and share it with us on Facebook or via email.

Resources:
- https://www.teachengineering.org/activities/view/cub_simp_machines_lesson05_activity_1
- https://www.youtube.com/watch?v=GOMIBdM6N7Q
- https://www.youtube.com/watch?v=ytV76_ZWprQ
- https://www.youtube.com/watch?v=QQ9gs-5lRKc
- https://www.youtube.com/watch?v=vCNVEmQ5lIM

Taking it Further! If you would like some extra challenge, add an extra step in the middle of your machine and modify it to still work.

Another way to challenge yourself is by choosing a difficult task. Something, like turning a doorknob, pouring a glass of water, or pushing a small button, will be much more difficult.