

# Chain Reaction Machine

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The rubber wheel connects to the dominoes, the dominoes connect to the mouse trap...

## Materials

- Different things from around your house.
- What you can't use is plug-in electricity or more than one cup of water.
- 1 2-foot long piece of 2x4 (for the top of your wood frame)
- 2 3-foot pieces of 2x4 (for the sides of your wood frame)
- 1 2-foot by 3-foot piece of plywood (for the base of your frame)
- deck screws
- screw driver (an electric one works best)
- brackets (angle brackets and brackets for copper tubing) for attaching different parts of your link to the frame
- staple gun

## Instructions

1. A Chain Reaction Machine uses natural forces, like gravity and elasticity, to make something happen. The chain is a series of simple devices like a pulley or some dominoes that knock into each other. The idea is to put together a few of these devices so that they go off one right after the other, like a chain reaction. Once you put the first one in motion, the rest of the machine should go by itself.
2. Check with a grown-up before you begin. You will need an adult to help you build a frame for your link in the Chain Reaction Machine. Make sure it's okay to use the objects you choose for your Chain Reaction Machine.
3. The ZOOMers used different types of string, rubber wheels, a drinking glass, fishing weights, springs, marbles, dominoes, magnets, mousetraps, different kinds of balls (metal ones, too), soda bottles, pulleys, levers, small battery-operated vehicles, electrical wire and wire clips, a small battery-operated fan, toys, balloons, helium, measuring sticks, cans, fishing line, straws, vinegar and baking soda, corks, baggies, cardboard, glue, feathers, glitter, plastic and paper cups, construction paper and tape. Basically you can use just about everything, even the kitchen sink.
4. Each link in your machine must begin and end with the pull of a string. This way when you finish building your links, you can connect them with string. The action of one link will make the action of the next link begin.
5. Decide how many links you want in your Chain Reaction Machine. You will build each link inside a frame. The frame makes the link stable and you can attach different parts of your link to it. If you use wood to build your frames, have an adult help you. If you don't want to build wood frames, use something freestanding, like an ironing board. Ironing boards are just about the right size for a frame, and the top usually has holes that you can use to attach wires, string, hooks, and paper clips. Just be sure to ask if it is okay to use it.
6. To build a frame out of wood, have an adult screw the pieces of 2x4 together into a U-shape no larger than four feet tall and two feet wide. Screw the 2x4 U to the plywood base so that the 2-foot 2x4 piece is at the top and the plywood base is at the bottom.
7. Find some friends, split into teams (one for each link) and start designing your links.
8. Here are some tips to keep in mind as you design: Make sure that there is enough force for the ending string of one link to pull on the starting string of the next link. Also make sure there's enough energy to keep everything in your links moving. Although you can't use plug-in electricity, you can use things like mousetraps, rolling marbles and other moving parts that gain energy when they are pulled down by gravity.
9. Once the frame is done and you've planned your design, ask an adult to help you attach the extra pieces of wood or cardboard that will hold different parts of your link. To mount wood pieces to your frame, use angle brackets. To attach round gadgets like wood dowels, use copper tubing brackets. For mounting cardboard tubes and other thin items, a staple gun works best.

# Chain Reactions

A cat scratches a piece of string. The string pulls down a lever. The lever releases a ball. The ball rolls down a track and turns on a radio... The chain reactions don't have to be just machines - they can tell a story, too.

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## Goals of the Workshop

- Get inspired to make a large construction out of many parts that all work together for a shared goal.
  - Experiment with materials and motion to find ways to trigger a sensor
  - Plan and revise your design to be part of the larger construction.
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## Materials

- Crickets, motors, and cables.
- Sensors - light sensors, touch sensors, and resistance sensors are especially useful
- Copper foil
- Marbles - glass and metal
- Building supplies: cardboard, 1" pink insulation foam, tagboard, wood scraps
- Stuff to attach with: cable ties, pipe cleaners, hot glue, glue sticks, masking and duct tape
- Stuff that can hold or move a marble: tubes, cups, spoons
- Stuff to decorate with: glittery paper, tinsel, and mylar, construction paper, "doo-dads" (little plastic toys & beads), yarn
- A selection of LEGO pieces: gears, axles, axle connectors, beams, [small grey pieces]. See the EZ modules pages for ideas on LEGO supplies.



## Working & Playing

- Recycled cardboard tubes are one way to move a marble through a contraption...
- But having other types of materials available can encourage other types of solutions & creations.
- This contraption featured two ballerinas on top made from styrofoam balls and little paper cups. When the dancers twirled, they moved a ball.
- This chain reaction started when the doll boot kicked the can.
- As participants worked, we asked them to keep thinking about how to add motors and sensors to the constructions.
- This contraption used a motor to lift a gate and release a marble down the tube.
- We reminded participants to talk to the people in the groups before and after there to figure out how the contraptions can connect.
- At least 20 to 30 minutes before the end of the time, we moved the contraptions into place in the chain reaction. Then they made adjustments to make sure their creation fits in with each of its neighbors.
- About 15 minutes before the end of the time, we held a practice run. This gave the group a chance to try the chain reaction, then make some quick last-minute adjustments before the official Final Run.

## Other Thoughts & Reflections

- Chain Reactions don't always work. (Maybe that's why you always end up telling stories: "The ball starts here when the squirrel spins and it rolls down the hill, where it was supposed to knock over the barrel....")
- The materials you provide help shape the workshop. It is usually much easier and faster to fashion structures out of craft supplies and use LEGO pieces as little as possible. Tubes are handy, but you can build really interesting chain reactions without using any tubes if you provide other kinds of building materials.
- Chain reactions take time. We led a 90-minute chain reaction workshop for adults and had barely enough time.
- It seems like it is hard for people to imagine how to build something that will move. I wish we had had some built examples on hand of the EZ Modules. They require a minimum number of LEGO pieces and can be adapted easily.