

Engineering Design: Ball Runs

Activity Overview

Children use a variety of materials to construct a pathway for a ball (or marble) to travel on and **explore** ways to direct the ball's movement. They **investigate cause and effect relationships** as they manipulate the materials in their structures. Using **trial and error**, children engage in **refining their designs**, **problem solving**, and **engineering solutions**.

*Science/Engineering skills are in bold.

Underlying Science Concepts:

- A ramp is a simple machine that is higher on one end that can be used to move an object from one place to another.
- The height of a ramp affects the speed of a ball and the distance it will roll.

Materials:

- Small balls (such as rubber bouncy balls or ping-pong balls) or marbles (marbles are not safe for children 3 and younger)
- Masking tape
- Blocks (wooden and foam)
- Empty boxes, such as tissue and cereal boxes
- Plastic containers, such as yogurt cups and strawberry baskets
- Assortment of wrapping paper, paper towel, and toilet paper tubes. Additional materials that could be added include: Plastic pipes, such as pvc pipes, foam pipe insulation or pool noodles cut in half, wooden train track pieces
- Optional: Photos (found online) of ramps used in the real world, such as wheelchair ramps, moving vans, horse trailers, skateboard ramps, rollercoasters, etc.



Literature Connection: "Roll, Slope, and Slide: A Book About Ramps" by Michael Dahl and Denise Shea.

Getting Ready:

- Collect the materials. The amount depends on how many children will be participating in the activity at one time. Since each child needs a fair amount of materials, this activity works best as a station.
- Prepare the paper tubes by cutting them to varying lengths. Cut most of the tubes in half length-wise, leaving a few tubes uncut.
- Play with the materials yourself to become familiar with their possibilities and limitations.
- This activity works well on the floor. Identify an area where children can spread out while working.

→ Engage

- Place a ball (or marble) on the floor. Ask the children how we could make the ball move. Children will likely respond with ideas such as *roll it, push it, throw it, etc.* Acknowledge that these are all ways that we can make the ball move. Demonstrate their different ideas.
- Lay the materials out in front of the children. Ask, “*What ideas do you have about how we could make the balls move using these materials?*” As the children share their ideas, establish that the materials can be used to make ramps and tracks for the balls to roll on. Demonstrate how to make a simple **ramp** (a surface with one end higher than the other). Model how to use the tape to hold things in place if needed.
- Emphasize that there are many different ways to make “ball runs,” and that they can try out lots of ideas. If something doesn’t work, try to fix it. Be creative!
- Ask the children to come up with rules to follow and go over any procedures you think are necessary for using materials safely, sharing the materials, and clean up.

→ Explore

- Encourage the children to experiment with different ways to construct ball runs with the materials. Notice what challenges they are setting for themselves and support their investigations by helping them notice cause and effect, encouraging them not to give up, helping attach materials, or providing additional materials.
- As the children build and test their ball runs they will engage in problem solving such as:
 - Figuring out what needs to be changed in order for a ball to go where they want it to go.
 - Connecting materials together to make a continuous pathway.
 - Making their structures stable and balanced.
 - Troubleshooting and finding solutions when their ball run does not work.
 - Constructing relationships between different variables and experimenting with cause and effect.
- Some children may want to document their ball run by drawing or making a diagram of it. You may want to take photos of their ball runs to document different designs and/or write down what the children say about their structures.

You may want to place pre-cut pieces of tape and tape loops on a tray to make it easier for children to use since tape dispensers can be difficult for little hands.

Children may work independently or collaboratively. Initially children will likely prefer to work independently, but as they get more experienced with the activity they may work together to create more elaborate ball runs. You might suggest trying to find ways to connect children’s ball runs together.



→ Reflect

- Allow children to leave their ball runs set up and invite them to talk about their design and demonstrate how it works. Encourage them to share some of the problems they encountered and what changes they made along the way.
- Connect the children's experiences building ball runs to the real world. Ask them to think of ramps they have seen before. Show pictures of things like slides, roller coasters, and skateboard parks and discuss how ramps are used to help move things that roll. Show photos of ramps in sidewalks, ramps on delivery trucks, and ramps instead of stairs and discuss how they help things like wheelchairs, carts, strollers, and other objects with wheels to be able to move from one point to another.
- Let children try to make ramps using their bodies. Try making steep ramps and more gentle ones.

Ideas for Further Explorations

- Create ramps for cars using cookie sheets, wooden boards, or heavy pieces of cardboard. Children can compare and measure the distance cars travel when using ramps of different heights.
- Create a set of ramp and pathways using lengths of wood cove molding, which can be purchased at a building supply store, into 1-, 2-, 3-, or 4-foot lengths. Use the book, "Ramps & Pathways: A Constructivist Approach to Physics With Young Children" by Rheta DeVries and Christina Sales to learn more. Visit the website associated with the book <http://www.uni.edu/rampsandpathways/>.

Key Vocabulary

During the activities integrate the words below into your conversations. Children's vocabulary will build with practice.

- Ramp
- Roll
- Track
- Predict
- Experiment
- Test
- Height
- Steep
- Support
- Structure

Positional and Directional Words:

Higher, lower, next to, between, on top of, under, behind, in front of, below, above, up, down, forward, backward, sideways, through, over

Teacher Tips

This activity is meant to be an open-ended exploration. There is no right or wrong way to do it! Notice how different children approach their investigations, the challenges they encounter, and the solutions they attempt.

Don't rush in to fix things; making mistakes is part of the learning process.

Make this activity available on a regular basis. Introduce new materials from time to time to enrich the activity.

Parents can be a great resource for collecting various materials.

Guiding Questions

As you observe the children at work, you will see them experimenting in many ways. Use questions and comments to promote deeper thinking and to focus attention on problem solving. It is important to let them make their own discoveries in their own time.

- What do you think you could do with these things?
- What happens if you make your ramp higher (or lower)?
- Where do you notice the marble coming off the track?
- I wonder why the marble comes off the track here?
- How can you catch a marble when it flies off the ramp?
- How can you make a marble turn a corner?
- How can you make the marble go faster? Slower?
- How can you make a marble go uphill?

(Above questions are excerpted from Ramps & Pathways "Tips for Implementation" at <http://www.uni.edu/rampsandpathways/resources/tips-implementation>)

Background Information for Teachers

A **ramp** is an inclined plane - an even surface that is tilted at an angle with one end higher than the other. Inclined planes are simple machines that make the work of moving things easier. You can use an inclined plane to move an object up or down. Using an inclined plane to lift a heavy object to a higher spot takes less force than lifting it straight up. Things will slide or roll down an inclined plane as gravity pulls them back to Earth from their elevated position at the top of the plane. The steeper a ramp is, the more quickly an object will roll or slide down the incline, and the farther it will roll after leaving the ramp.

The speed that an object moves down a ramp is also affected by friction. Friction is a dragging force that happens when objects roll or slide against each other. There is less friction for a ball to roll on a smooth plastic track than on a textured foam track so it goes faster on the plastic track.

Some ramps used in the real world are slides, slanted driveways, wheelchair ramps, delivery truck ramps, slanted roofs, and rollercoasters.