Ramps and Pathways: An approach to teaching physical science and engineering in early childhood

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Ramps and Pathways

An approach to physical science and engineering that involves inclined planes and the movement of objects.
Why Physical Science?

Physical science activities:
- intrigue children
- inspire children’s curiosity
- stimulate children’s reasoning
Why Engineering?

Engineering activities:

• Appeal to children’s desire to make something interesting happen

• Foster initiative, problem-solving, persistence, and creativity
Integrating Science, Technology, and Engineering in Early Childhood
Technology: any modification of the natural world done to fulfill human needs or desires
Engineering: an approach to designing objects, processes, and systems to meet human needs
Engineering:

Design under constraint

Typical engineering constraints:

- Laws of physics
- Materials and their properties
- Space
- Time
- Budget
How do I get the marble to move?
Let’s Take a Closer Look

Watch the child facing the camera in the navy blue sweatshirt.
• Cove molding
  – 1’ to 4’ segments
  – 1 ¾” wide

• Marbles
  – For young children, 35mm marbles will not go down a choke tube.
Materials to Add

- Items that will not roll or roll differently (cubes, wooden eggs)
- Marbles that are the same size, but different weights
Supports

- Unit blocks
- Large cardboard or Duplo blocks
- Boxes with holes
- Chairs
- Shelves
- Children will use whatever is around them!
Constructivist Theory

• All new knowledge is constructed on a base of existing knowledge and experiences.
• Children learn when provided opportunities that challenge their existing ideas; this requires a safe environment in which children do not fear errors or mistakes.
• With intentional support and guidance from skilled and knowledgeable teachers, children can gain knowledge, skills, and dispositions.
Children learn by:

Trying out their ideas.
Children learn by:

Making “mistakes.”

“A person who never made a mistake never tried anything new.”

Albert Einstein
Having a feeling of contradiction when their ideas do not work as they expect.

Children learn by:
Children learn by:

Trying again with the new information in mind.
Criteria for Good Activities

Producible:
Children should be able to make something happen on their own.
Immediate:
The result should happen right away.
Observable:
Children should be able to observe the result on their own.
Variable: Children should be able to change something in order to get a different result.
Let’s try an activity!
What can children learn?

Exploring Properties of Objects

Spherical objects roll.
Exploring Object Properties
Investigating Causality
When the track is flat, the marble will not move.
When the track is too steep, the marble just bounces.
When the second track is *over* the first track, the marble stops.

When the second track is *under* the first track, the marble keeps going.
Let’s Take a Closer Look

Notice how these two children are investigating the causal relationship between the release point of the marble and where it falls to the floor.
Next Generation Science Standards

• Science and Engineering Practices
• Crosscutting concepts
• Disciplinary Core Ideas
Scientific and Engineering Practices

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
Scientific and Engineering Practices

5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating and communicating information
Crosscutting Concepts

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change
Disciplinary Core Ideas

Physical Science
- PS1: Matter and interaction
- PS2: Motion and stability
- PS3: Energy

Engineering, Technology, and the Applications of Science
- ETS1: Engineering design
- ETS 2: Links among engineering, technology, science and society
Notice how many of the NGSS you see in this short video.
Productive Questions

• Attention-Focusing Questions
  – Have you seen? What do you notice about?

• Measuring and Counting Questions
  – How many? How long? How much?

• Comparison Questions
  – How are they the same or different?

• Action Questions
  – What happens if....?

• Problem-Posing Questions
  – Can you figure out how to...?

• Reasoning Questions
  – Why do you think...?
Notice how this teacher supports children’s problem-solving ideas.
Questions and Discussion
What Children Build with Ramps
Single Track Ramps
Building Tunnels
Catching the Marble
Turning a Right Angle Corner
Turning Acute Angle Corners
Turning an Obtuse Angle Corner
Turning Multiple Corners
Making the Marble Jump
Multi-tiered Structure
Adding Loops
Multiple Hills
Questions and Discussion