

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



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Ramps and Pathways

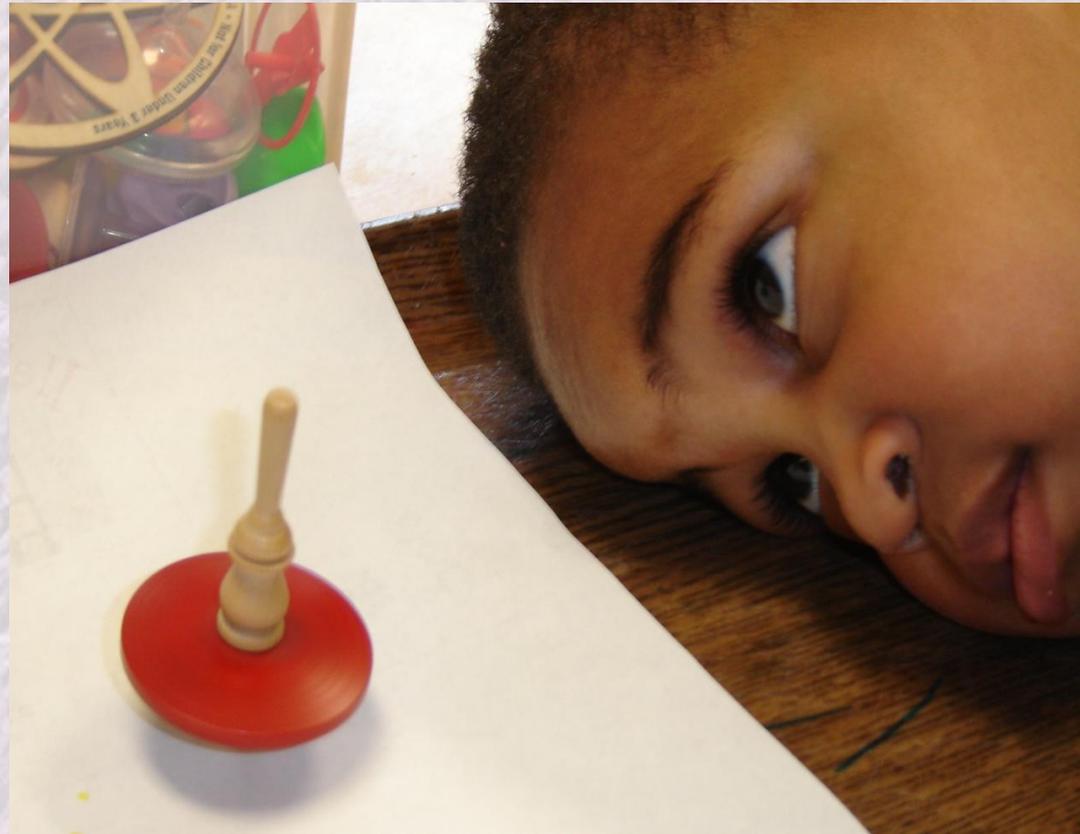


An approach to physical science and engineering that involves inclined planes and the movement of objects.

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



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





Design under constraint

Typical engineering constraints:

- Laws of physics
- Materials and their properties
- Space
- Time
- Budget



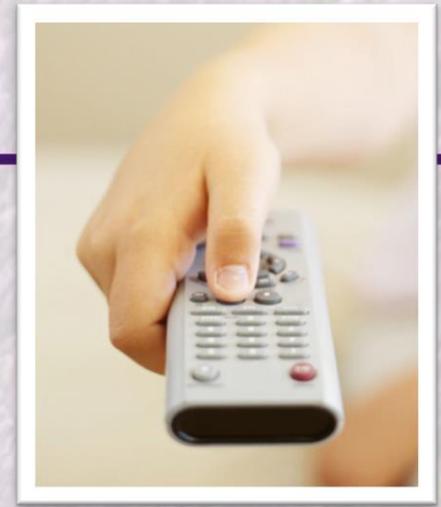
Engagement Activity



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 3/4" 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

Children learn by:



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

Children learn by:



Trying again
with the new
information in
mind.



Criteria for Good Activities

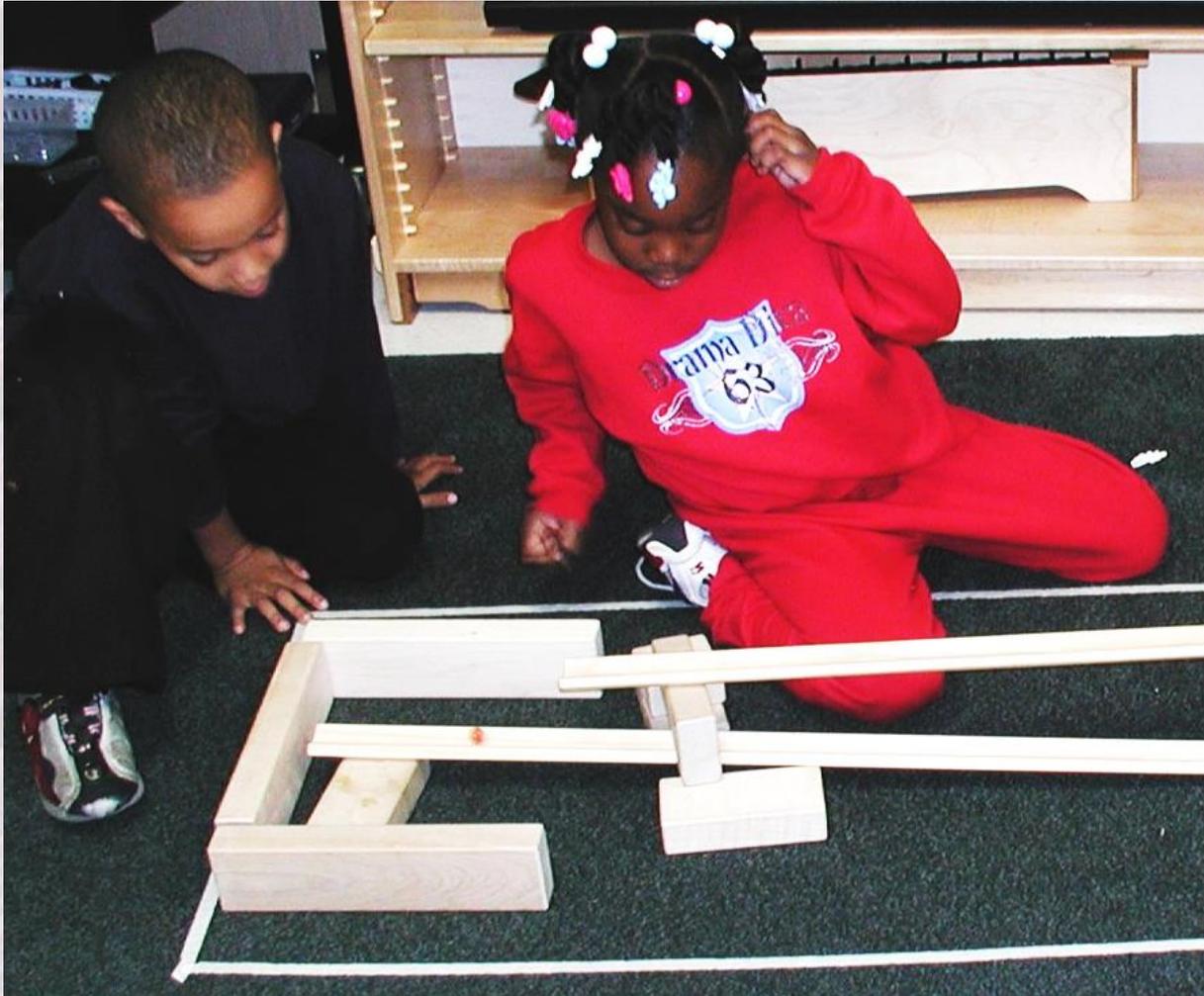


Producible:

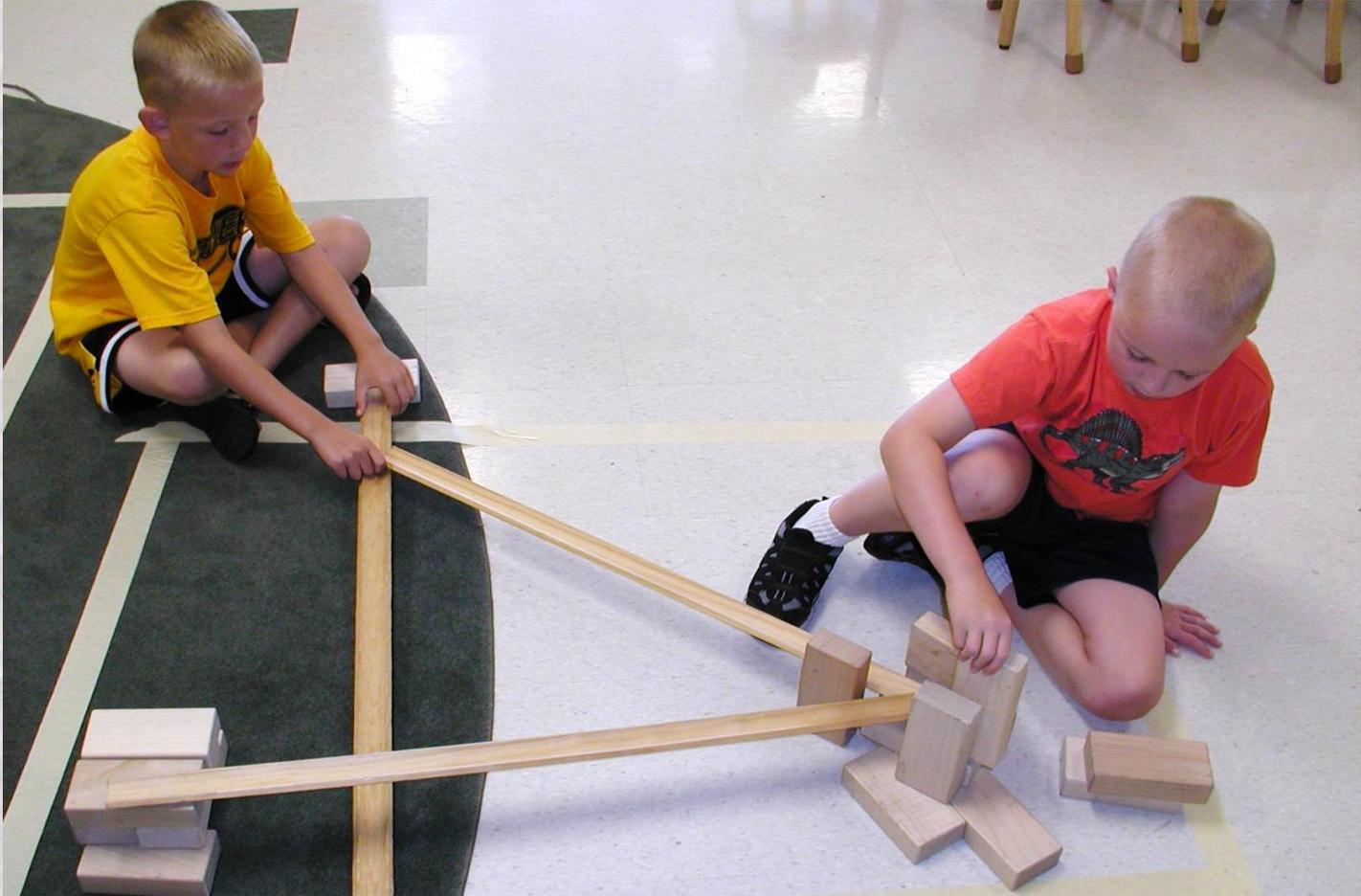
Children should be able to make something happen on their own.



Immediate:
The result
should happen
right away.



Observable:
Children should
be able to
observe the
result on
their own.



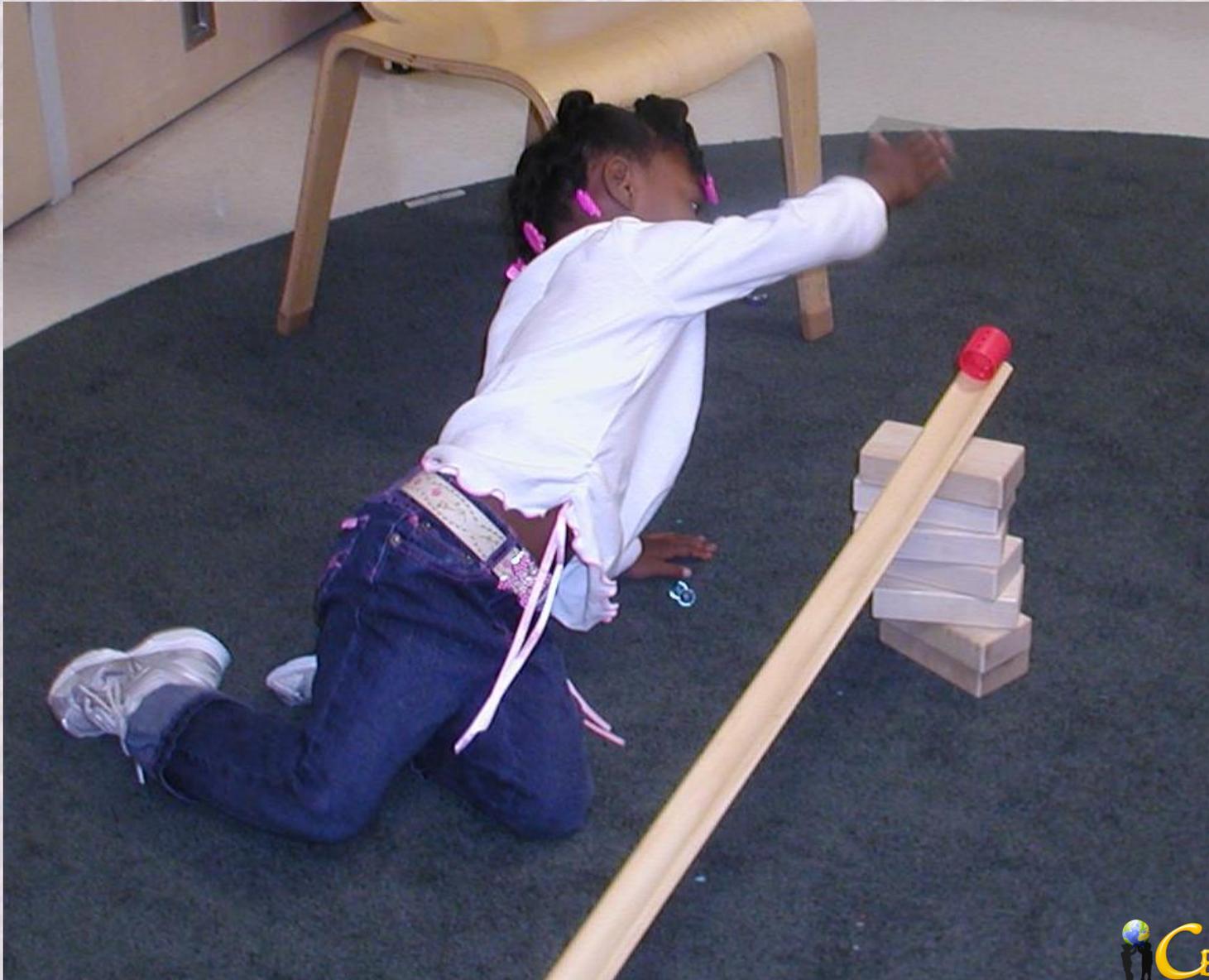
Variable: Children should be able to change something in order to get a different result.

Let's try an activity!

Exploring Properties of Objects

Spherical objects roll.







Exploring Object Properties





Exploring Object Properties





Exploring Object Properties



Investigating Causality





When the track is flat, the marble will not move.

Investigating Causality

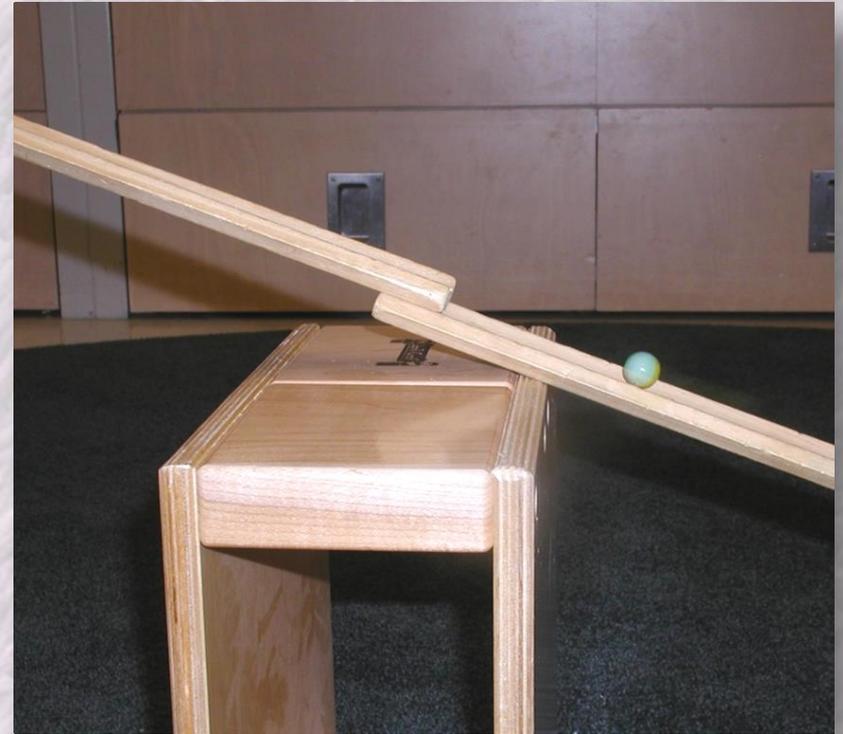
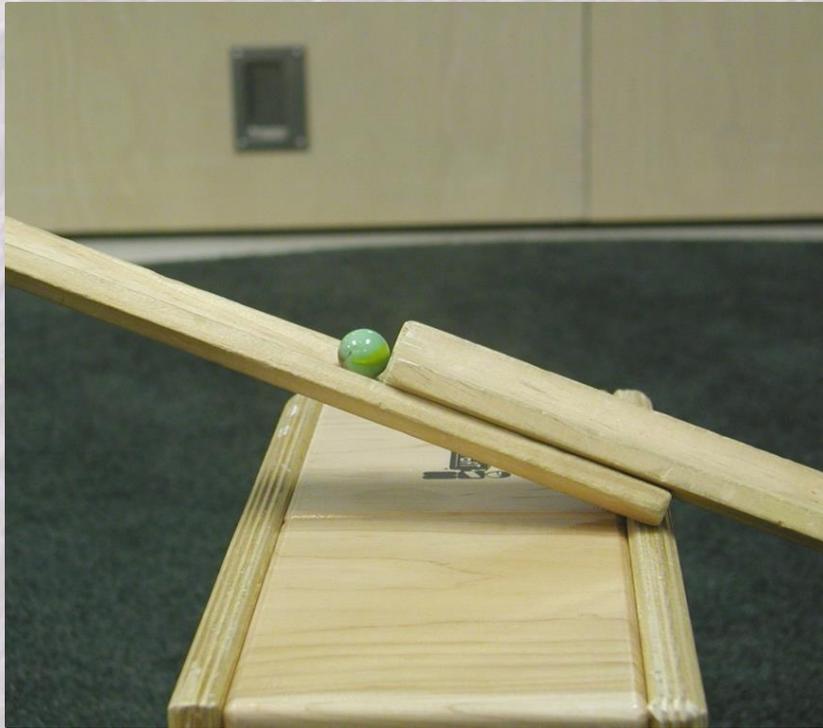


When the track is too steep, the marble just bounces.

Observing Closely



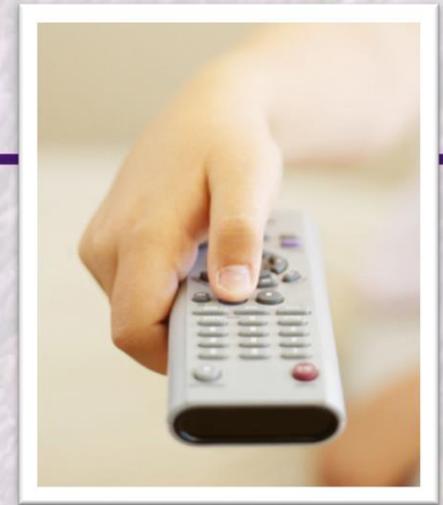
Problem Solving



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

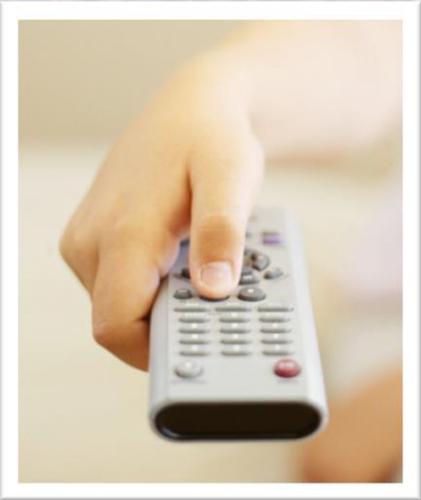
Engineering, Technology, and the Applications of Science

ETS1: Engineering design

ETS 2: Links among engineering, technology, science and society



Let's Take a Closer Look



Notice how many of the NGSS you see in this short video.

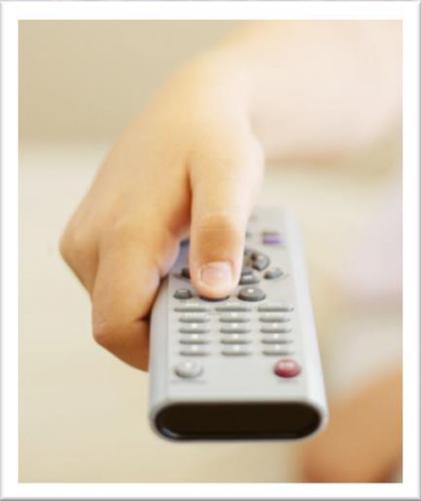


Productive Questions

- **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...?



Let's Take a Closer Look



Notice how this teacher supports children's problem-solving ideas.

Questions and Discussion



What Children Build with Ramps

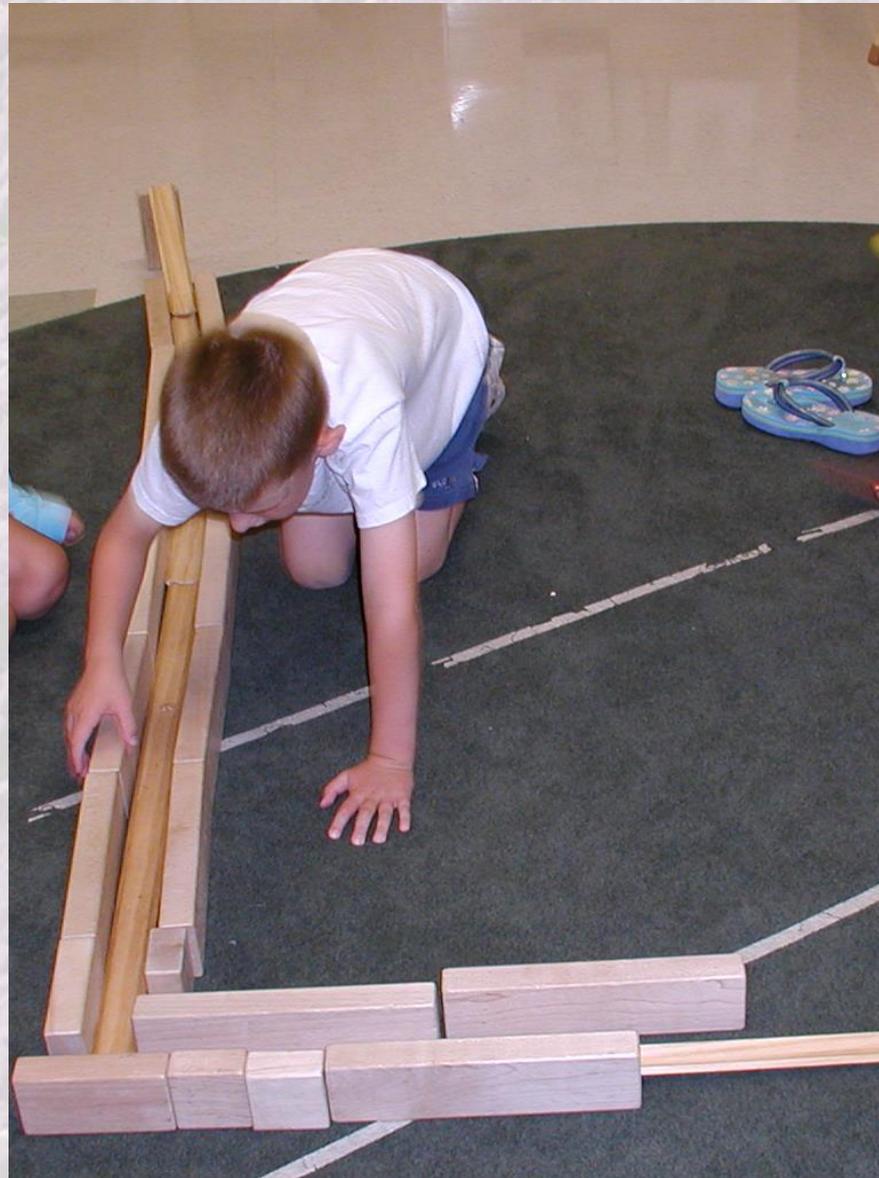
Single Track Ramps



Long Straight Ramps



Walls for the Pathway



Building Tunnels



Catching the Marble



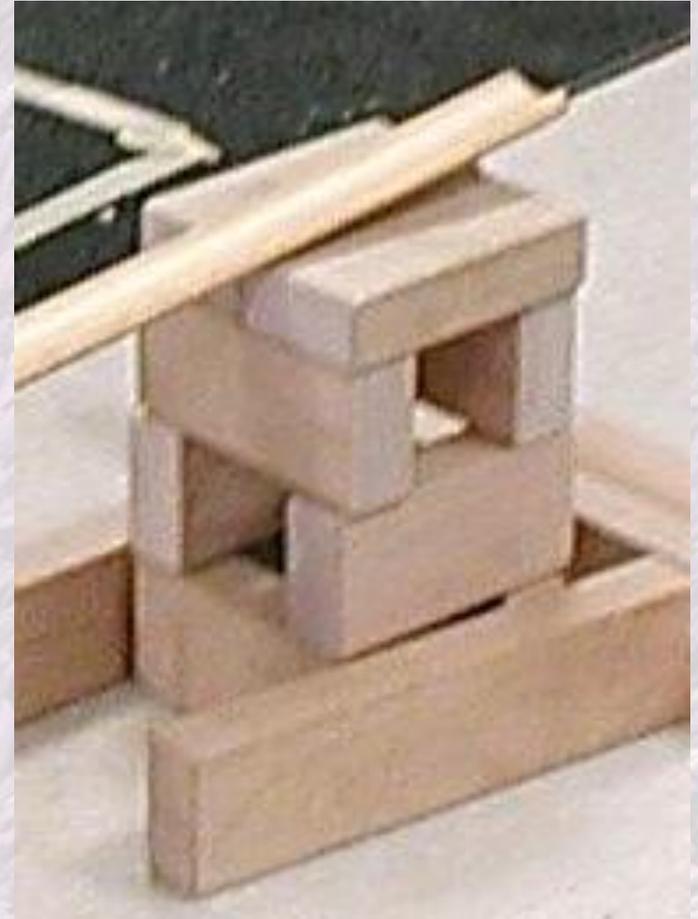


Unstable Foundation





Stable Foundation



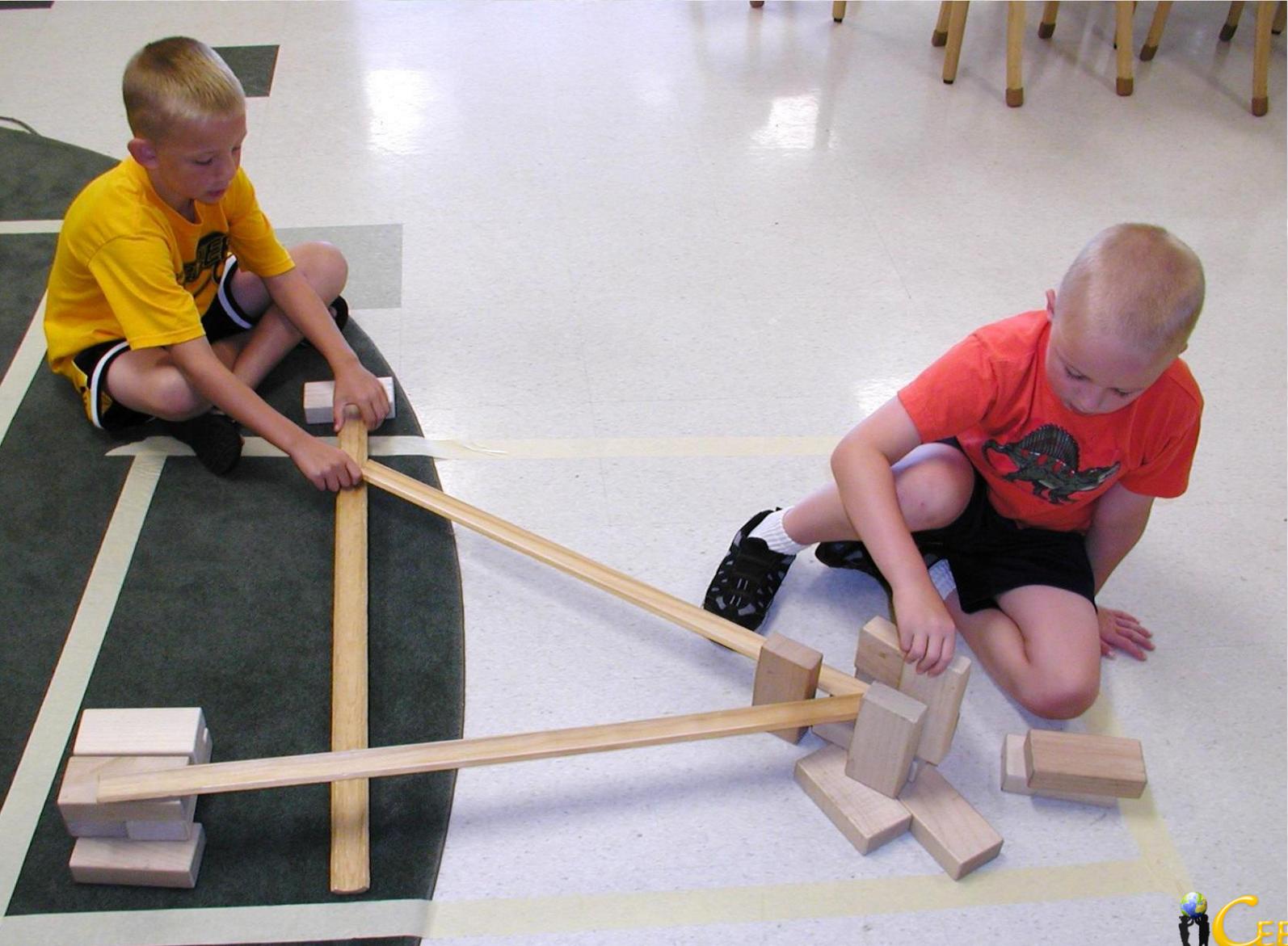


Turning a Right Angle Corner





Turning Acute Angle Corners





Turning an Obtuse Angle Corner



Turning Multiple Corners



Non-Essential Structures





Making the Marble Jump



Creating a Drop



Multi-tiered Structure



Adding Loops



Creating a Hill





Multiple Hills



Observing Closely



Questions and Discussion

