

Problem Solvers Activity SE 17: Stop It

CHILDREN ARE LEARNING...¹

Science Content:

- That different surfaces can affect the speed of an object's motion on a ramp or on a flat surface.
- That people can solve problems through engineering.
- That it is useful to compare and test designs because there is always more than one solution to a problem.

CHILDREN ARE DOING...

Science Practices:

- Ask questions
- Make observations
- Design solutions
- Analyze data (to determine if a design works as intended)

MATERIALS NEEDED:

One ramp for every 2 students—**See Unit 15 for instructions on constructing ramps.**

2 toy cars

For the engineering activity: *Collect a mix of materials that will help children slow down and contain a toy car rolling off the ramp—for example:*

2-3 blankets or dish towels

4 smallish boxes of different sizes—shoe boxes, etc.

Blocks of different types

Sandpaper (several sheets for children to share)

2 rug squares (if available)

3-4 pieces of tin foil, felt, or other textured paper

4 bean bags

Masking tape

Other items that children find and discover in the classroom!

¹ Adapted from the Next Generation Science Standards (kindergarten): <https://www.nextgenscience.org/>

PREPARATION:

- **For the EXPLORE activity:**
 - Position two ramps (for a group of 2 children, 3 ramps for 6 children) with enough space between them so children can roll toy cars down the ramps.
 - Keep the toy cars close by.
- **For the ENGAGE activity:**
 - Have the engineering construction materials displayed in a place that's easily accessible to children.
 - Review the Engineering Design Process (found in Unit 21) so the steps are familiar to you.

Activity Instructions

ENGAGE

Gather a group of 4 children at a table or in a circle on the floor. (Note: Groups of 6 children work well if you are teaching 4-year-olds. Adjust materials as needed.)

EXPLAIN: Do you remember when we explored ramps? Can anyone tell me how ramps work?

You might ask guiding questions like:

- What happens when we put something at the top of a ramp and let it go?
- Does everything roll down a ramp or just some things? What makes something roll down a ramp?
- What happens when things roll off the ramp?

SUMMARIZE: Summarize children's knowledge of how a ramp works. Focus on key messages like the ones below:

- Objects that are rolling *down* the ramp continue rolling *off* the ramp when they get to the end.
- Rolling objects continue rolling until they gradually slow down and stop on their own, or bump into something and stop.

EXPLORE: Place the children in pairs and give each pair a toy car. Encourage them to experiment and explore with the toy car on the ramp. Observe together what happens to the car and how far it rolls off the ramp before it stops. This free play will set the stage for the next part of the activity.

EXPLAIN: Today we are going to be Problem Solvers because we have a challenge to figure out! Our challenge is building something that will make our cars stop really quickly after they roll off the ramp. We don't want the cars to bang into something else in our community! So you are going to be engineers today and design a way for your car to stop after it comes off the ramp. Are you ready to be engineers?

TEACHER'S TIP

Why don't rolling balls roll forever? It's because of friction! The force of friction—produced as the ball is rolling over a surface—slows a ball down and will eventually make it come to a stop. You and your students discussed friction in Unit 16 (So Slow), so you might want to re-introduce this concept and vocabulary word.

EXPAND

PREPARE: Today we are going to design and build a way to stop your cars when they roll off the ramp. Let's talk about how we'll do this.

ASK: Help children organize their thoughts about the task by asking questions like:

- Does anyone have ideas about how to stop the car when it rolls off the ramp?
- Is the car rolling fast down the ramp? Is there anything we can do to slow the car down on the ramp, so it's not going so fast at the end?
- What can we do to make sure the car stops quickly?

SHOW: Show children the engineering construction materials.

EXPLAIN: We need to create a design plan for something to stop the car. Take some time to explore our construction materials. You can also look around our room for other materials you might like to build with. What can you do with these materials to build something to stop your car? Think about what you can make with these materials to solve our problem of stopping the car. Talk with your partner about what the two of you might build.

OBSERVE: Give children time to explore the materials. Some children may begin building right away. Other children may explore the materials to discover what they can do and how they work. Allow 5 minutes or so for exploration, more if children are very engaged.

ASK: If you wish, use the questions below to focus children's attention on the task:

- What can we do with these materials?
- What do you think you'd like to build in order to stop your car?
- What could you do with (material)?
- What materials do you like the best for stopping your car? Why?
- What are you thinking of building? What will it look like?

SUMMARIZE: I'd like to hear about your plans for stopping the car. Can you share your ideas? (*Ask each group. Help them put into words their idea or their actions. Tie these to the overall goal: stopping the car.*)

TRANSITION: Now, we're going to build the plan you have in mind. After you build it, we'll test it to see how it works and you'll have a chance to make it better if you'd like.

EXPLORE

EXPLAIN: The next step of the engineering design process is to create, or build, our car stopping tool. You already explored these different materials. You used that knowledge to come up with ideas about how to stop the car. Now you can use that plan to build with your partner.

SUPPORT: Give children time to build their solution to the car-stopping task. Support children's attempts. Offer assistance with materials like masking tape, if needed. Some children may need help getting started or organizing themselves; you can assist by asking guiding questions like the ones below, if needed:

- Can you tell me about your design plan? What materials will you start with?
- What made you choose these materials? How will they help you stop the car?
- What materials will you use to slow the car down?
- Tell me what made you choose those materials to stop the car? What makes those materials good ones for slowing down the car?

- What's tricky about your design plan?
- Do you have any questions or challenges that I can help with?

OBSERVE: The teacher's role during the **Create** step of the engineering design process is to observe the children as they build in order to support their learning.

- Younger children may have difficulty knowing how to start—see the questions above for guidance on supporting them. You may need to scaffold, or support them through the design and building process, while keeping them engaged and participating.
- All preschoolers may need help in organizing themselves to act on their plan. You can help by (1) reminding them of the goal of the activity, (2) observing what they have already done—"I see you have chosen bean bags" and (3) prompting them to consider the next step—"What do you think comes next in your plan?"
- Preschoolers may also have difficulty imagining the cause and effect involved in this activity: what they build affects how the car responds. Encourage them to test their plan along the way to finetune and make mid-course discoveries and corrections.

SHOW: Remind children of the problem: We have to build a solution that will stop the car when it rolls off the ramp. When children have created their stopping solution, ask each pair to say what they did and demonstrate it for the group. Focus on helping children explain the steps they took and their plan for stopping the car.

ASK: The last step of our engineering design process is to see if we can **improve**, or make our design better. Would you say that your design is successful—did it stop the car?

ASSESS: Help children assess the success of their design using questions like the ones below:

- If your design didn't stop the car, what do you think happened? What could you do to improve your design?
- Is there anything you would like to change?
- Did any of your friends have good ideas that you would like to try?

ASK: Engineers try a design and test it. They figure out how to improve it over and over again, until they get a design that really works well. Is there anything you and your partner would like to do to make your design better?

OBSERVE: As children refine their designs, watch to see what (if any) changes they opt to make. Some children may use this time to simply play with the ramp and stopping solution—which is okay. If you see that a design is not working, use the questions suggested above to encourage children to explore other approaches. If children did change their design, give them another opportunity to share the actions they took and to demonstrate their design.

REFLECT

To close the activity, bring the children back together. Use a reflective question/s - like those below - to prompt children's thinking about engineering design.

- What did you enjoy about building your stopping solution today?
- What was tricky about building your stopping solution?
- What did you discover about ways to stop a rolling car?
- When the car goes down the ramp, what can you do to make it go slower?
- Tell me about how your stopping solution works.

SUMMARIZE: Today, we used the engineering design process to stop our toy car as it rolls off the ramp. First, we explored our materials. Then, we created our stopping solution. And finally, we thought about ways to make our solution better. We were Problem Solvers and engineers today!

Individualizing the Activity

Make it more challenging:

- In the **EXPAND** activity, offer pairs of children a piece of chart paper and markers/crayons to draw their design plan prior to building it. Remember, it's okay if children don't accurately depict their plan. It's the process of translating thoughts to paper (or attempting to do so) that is important here.
- Give children several different toy cars (of different weights/sizes) to use when testing their design solution. Encourage them to make improvements so the design can work with a variety of cars.
- Have children build their solution 12-18 inches away from the bottom of the ramp. This positioning means they need to ensure the car is guided into the design, which adds another problem to solve.
- Make the incline of the ramp steeper, meaning the cars will travel faster. Encourage children to test their design again to see if still works.
- Sometimes what *doesn't* work can be an insightful learning experience for children. You might consider purposefully creating a solution that doesn't work and see if children as a group can help you think about how to improve it.

Make it less challenging:

- Conduct the activity (**EXPLORE** and **EXPAND**) as a whole group activity so you can guide and scaffold children's planning and problem-solving. If time allows and the group is ready, you can run the activity again with children in pairs.
- Provide limited materials for the building component of the activity to reduce distraction/overwhelm.
- When it's time to test the children's solutions, share observations about what you see (*I see the car didn't stop, it just kept rolling*) with no judgment. Help children make the leap to problem-solving by modeling your own thinking: *I wonder what is on our table that we could use to stop the car. Maybe the bean bag or pillow might work?*

MAKING CONNECTIONS ACROSS THE DAY:

- Add a ramp and open-ended materials to the block area and encourage children to build different "solutions" – how to stop cars, or how to direct cars to the left or right.
- Include a clipboard with paper and crayons in the block area to encourage the creation of design plans.
- When children face a challenge as they play, ask what solution they think might work. Give them time to test that idea and refine it if needed.
- Normalize the fact that sometimes it takes several tries for something to work. If children become frustrated that—for example, the wooden toy tracks aren't fitting together—remind them that sometime engineers have to try building something many times before it works.

Song: Car Go, Car Stop

Listen and model the Go and Stop movements as indicated in the song. Encourage children to listen and GO and STOP with you as you move around the room.

Hello Problem Solvers!	(Wave hello)
It's time to rev your engines.	(Make revving sounds)
Get your motor running	(tiptoe feet in place quickly)
And get ready to go go go!	(start moving around the room, like driving a car)
Watch that road!	(Point ahead)
Watch out for other cars!	(Look around while moving)
If you bump someone else	
The force will push you in the wrong direction!	(shake head no)
Now watch out	(Look around)
I see a traffic light!	(point ahead)
When it turns red	
We have put those brakes on	(pretend to push brake pedal)
and STOP!	(stop body suddenly)
But keep your motor running	(Make revving sounds again)
Rev it up again	(tiptoe feet in place quickly)
Because when that light turns green...	
We GO!	(start moving around the room again)
Now we're driving up a big hill	(point up)
Climbing, climbing so high	
As we start going down down down	(point down)
We go faster and faster, like a big ramp!	(move faster)
But watch out...	(look around)
There's a stop sign at the bottom of the hill	(point ahead)
Put on your brakes...	(pretend to push brake pedal)
And STOP!	Stop body suddenly)
Now music means GO	(Stand still, listening to the directions)
And no music means STOP!	
Ready? Listen for when to GO and STOP!	
Go!	(Go when you hear music playing)
Stop!	(Stop when the music stops)
Go!	
Stop!	
Go!	
Stop!	
Go!	
And STOP!	
Great driving, Problem Solvers! You know when to go and stop!	(Thumbs up)

Making Literacy Connections

Share the following book with children as an opportunity to deepen their understanding of friction, rolling, and stopping.

Suggested Book: *Roll, Roll Little Pea* by Cécile Bergame

Note: A very similar title is *The Runaway Pea* by Kjarten Poskitt, which is written for slightly older children (ages 4-6 years).

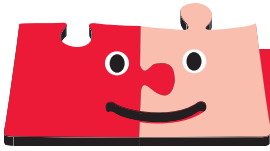
AS YOU READ:

- The book begins with a girl sitting at the table, shelling peas. Do the children know what it means to shell peas? It is when we open up the pea pod (show children in the illustration) and take the little peas out so that we can eat them.
- When the pea escapes, can children find it on the page? (It's in the lower right-hand corner.)
- The phrase "Roll, Roll, Little Pea" is repeated throughout the story. As you point to this text, prompt children to chant these lines along with you.
- Each animal who sees the pea wants to eat it. The author uses different verbs to describe their desire to snack on the pea, starting with the mouse who wants to "taste" the pea. Encourage children to act out each animal, make their sound, and pretend to taste the pea. Other animal/verb pairs include: cat/crunch, rabbit/nibble, hen/peck, pig/munch, wolf/devour.
- The pea who escaped has been rolling through the house and yard and not stopping. When does the pea finally stop rolling? (When "the earth swallowed the pea.") What does it mean that the earth swallowed the pea? (The pea has rolled into a hole in the ground.)
- What happens to the pea after it lands in the dirt and the rain falls and the sun shines? (The pea grows into a new pea plant.)
- The final word of the book is "VOILÀ!" This French word is pronounced "Vwa-lah" and it means "there it is!" Ask children if they can find peas and pea pods on the plant's branches.

BUILD ON THE BOOK: PLAY ROLL, ROLL LITTLE PEA OUTSIDE

Materials: Tennis ball, black marker. Draw two eyes and a mouth on the tennis ball.

1. Tell children that they will play Roll, Roll Little Pea outside. Each child will have a turn to roll or bounce the "Little Pea" and then the children can chase the pea to where it stops and the next child has a chance to roll or bounce the pea. (Important rules: No throwing, only rolling/bouncing.)
2. Continue until all children have had a turn to roll/bounce the pea.
3. If you wish to add a literacy connection, take a photo of the pea in every place he stops, print out photos, and glue each to a separate piece of paper. Assemble the pages and have each child tell you what to write on "their" page. Put the pages in a binder and share as the "Teacher's Name Roll, Roll Little Pea Book."

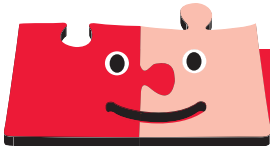


Solving Engineering Problems

This week, children were engineers and built a way to stop a toy car rolling off a ramp! You can help children practice their engineering skills at home by trying this activity:

- Gather about ten empty plastic storage containers, takeout containers, and/or small boxes. Tell your child that together, you will build the highest tower that you can.
- Before you start building, explore these items with your child. Which is the biggest? Which is the heaviest? Which are the smallest and lightest?
- When you start building, ask your child what their plan is. What would they like to put on the bottom? What goes next? What should go on top? Let them take the lead.
- If the tower falls down, that's okay! The last step of an engineering design plan is to make it better. Help your child problem-solve how to make their tower more stable, taller, or stronger. Take a picture of it when you're done!





Solo para familias

Cómo resolver problemas de ingeniería

Esta semana, los niños fueron ingenieros y construyeron una forma de detener un auto de juguete que rodaba por una rampa. Puede ayudar a los niños a practicar sus habilidades de ingeniería en casa con esta actividad:

- Reúna unos diez envases de plástico vacíos, envases de comida para llevar o cajas pequeñas. Dígame a su niño que van a construir juntos la torre más alta que puedan.
- Antes de empezar a construir, examine estos objetos con su hijo. ¿Cuáles son los más grandes? ¿Cuáles son los más pesados? ¿Cuáles son los más pequeños y livianos?
- Cuando empiecen a construir, pregúntele a su hijo cuál es su plan. ¿Qué le gustaría poner en la parte inferior? ¿Qué va después? ¿Qué debería ir arriba? Deje que tome la iniciativa.



Si la torre se cae, ¡no importa! El último paso de un plan de diseño de ingeniería es mejorarlo. Ayude a su hijo a resolver el problema de cómo hacer su torre más estable, más alta o más fuerte. ¡Hágale una foto cuando terminen!