

Problem Solvers Activity SE 18: Bowling and Rolling

CHILDREN ARE LEARNING...¹

Science Content:

- Pushes can have different strengths and directions.
- Pushing an object can change the direction and speed of its motion.
- When objects touch/collide, they push on one another and can change motion.
- A bigger push makes things speed up more quickly.

CHILDREN ARE DOING...

Science Practices:

- Explore cause and effect
- Make predictions
- Observe patterns
- Plan and carry out investigations

MATERIALS NEEDED:

10 clean, empty plastic soda/water/juice bottles (any size is fine, but all should be the same size)

2 small playground balls

4 shoebox or shirt box lids (one per child)

1 straw per child, plus 1 for the teacher

4 small pom-poms

Optional: 10 small sticky notes

Masking tape

Handout 1: Examples of Collisions

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

PREPARATION:

- **For the ENGAGE activity:**
 - Print **Handout 1**. If you'd like, separate the photos and glue each to heavy paper or cardboard. Have the photos ready to show children for the introductory conversation.
- **For the EXPAND activity:**
 - Find a place in the room where 2 pairs of children can "bowl" against a wall. They will each need several feet of open space in front of the wall to serve as their bowling "lane."
 - Optional: Keep the sticky notes handy to mark where the pins go on the floor. This helps children replace the pins independently as they play.
- **For the EXPLORE activity:**
 - Turn the box lids over so the inside flat surface of the lids are facing up. On that flat surface, lay a dotted line of masking tape (or make a line with markers). This will be the pom-pom racing track. Keep the straws and pom-poms aside until needed.

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.)

ASK: What happens when one thing bumps into another thing? (*Explore children's experiences using questions like the ones below.*)

- Have you ever seen a ball bump into a wall? Where did the ball go?
- Have you ever bumped into another person by accident? What happened?
- Sometimes when we play with cars or trains, we bump one car into another one. What happens to the car that's bumped?

Summarize children's knowledge of what happens in a collision.

EXPLAIN: Today we're going to be Problem Solvers and explore *collisions*. Does anyone know what that word means? (*Take children's ideas.*) A collision is when one thing bumps into another thing, like when a ball hits the wall and bounces off. We also see collisions when the bumper cars at an amusement park hit one another. (*Show picture on Handout 1.*) We also see collisions during some sports like bowling, when the ball hits the pins. (*Show picture on Handout 1.*)

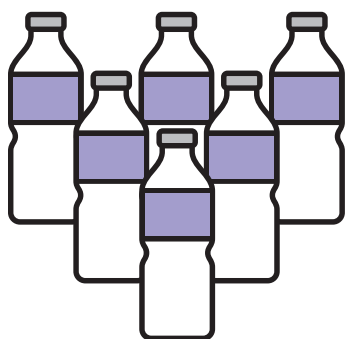
EXPLAIN: Today we are going to explore collisions. Let's see what we can discover!

EXPAND

PREPARE: We'll start by talking about some action words. Do you know what an action word is? It's a word that describes a movement, so I'm going to need your help. We're going to act out these action words.

- Who can tell me what a **push** is? *(Take children's ideas.)* A **push** is when we press or force something to move away from us. Can you stand up? Let's pretend to **push** something in front of us. *(Model this movement. Remind children not to push one another, but to pretend to push something away.)*
- Has anyone heard the word **force** before? Force is the push or pull of an object that makes it move. Let's pretend to push with a A LOT of force! *(Pretend to push hard.)* Now, let's push with just a little bit of force. *(Pretend to push gently.)* Okay, let's all sit down again.
- Hmm, what about this word called **motion**? Motion is when something moves, like this *(scoot yourself over a foot or so)*. Can you show me your own **motion**? While we're sitting, we can pretend to swim our arms like a fish or wave our arms like bird wings. Our body is in motion!

EXPLAIN: Now, let's play a game where we can learn more about pushes, pulls, and motion. Our game is called **bowling**, like the picture we saw earlier. Has anyone gone bowling before? *(If they have, ask the child to explain the game.)* In bowling, we use a ball to try to knock down these objects, called **pins**.



As you are talking to children, set up 6 plastic bottles (pins) with 3 in the back row, 2 in the middle row, and 1 in front (see image to the left). Stand a few feet away from the pins with the ball.

ASK: What do you **predict** will happen if I roll this ball toward these pins? *(Take children's predictions.)* Let's see! *(Roll the ball toward the pins and describe what happens: I pushed the ball with some force. The ball was in **motion**. Then it **collided** with the pins. The ball **pushed** down 3 pins.)*

ASK: I have a tricky question for you. What made the ball move? *(Take children's ideas. Explain that the ball moved because you pushed it—you touched the ball and put it in motion.)*

ASK: What made the pins fall down? *(Take children's ideas. Explain that when the ball collides with the pins, the force of the ball pushes the pins down.)*

EXPLAIN: Now it's your turn. Would you like to bowl with me? Let's explore pushes, motion, and collisions. A collision is when one thing bumps into another!

REVIEW: Review safety rules if needed (like – no throwing the balls, only rolling), or for older children, ask: What do you think are some rules that can keep us safe when we're using balls inside?

TRY IT: Divide children into pairs and give each pair a ball and 5 pins. One pair can use the set-up you created for the demonstration. Model how to place the pins with 3 in the back row, 2 in the middle row, and 1 in front. Count as you place each pin in each row. *(It can be helpful to put small sticky notes on the floor in the 3, 2, 1 pattern so that children can replace the pins independently as they play.)*

EXPLAIN: First, I want you to try rolling the ball to the pins. See what happens. Then put the pins back and let your partner have a turn. *(Let children explore the game for a bit.)*

STEM TIP

Point to and count the pins that have fallen to model the **counting** sequence and the concept of **cardinality** (the idea that the last number counted is the total number of objects in the set).

Also, setting up pins as described here gives children experience with creating a **spatial pattern**.

ASK: Now, let's do some science! Let's try rolling our balls in different ways.

1. Let's try rolling our ball **very, very gently**, with just a little force. (*Demonstrate.*) What do you observe? What happened? What did you learn about gentle pushes? (*Notice if children hit fewer pins with a gentle push. Notice if the pins didn't move or scatter as far with a gentle push.*)
2. Now let's try rolling our ball with **more force, using a strong push**. What do you think might happen? Will the pins move differently this time? What did you discover about strong pushes? (*Ask children for their observations. Notice how more pins were pushed down. The pins often move or scatter farther with a firm push.*)

If time allows, explore the variable of distance:

- Now **let's take 10 big steps** away from the pins and roll our ball. What do you think will happen? Will we hit a lot of pins? What did we observe? (*Notice if the ball rolled off target. Notice how the ball slows down as it rolls. It may also hit fewer pins.*)
 - Now **let's stand just 3 big steps** away from the pins and roll the ball. What do you think will happen this time? What did we observe? (*Notice how it's easy to knock down all the pins because the ball doesn't have to move very far to reach the pins.*)
3. Let's roll our ball one more time. Let's watch: Does it roll in a straight line or a crooked, zigzag line? Yes, a straight line. Has anyone observed what happens **when the ball rolls against the wall**? (*Take children's responses.*) Yes, the ball touches the wall and bounces off. The ball also changes directions, doesn't it? That's because once an object is moving, it moves in a straight line unless something gets in its way—like the wall.

TRY IT: Give children some time for free play before moving on.

OBSERVE: The teacher's role during this part of the activity is to observe the children at play. Focus on sharing the following messages as you observe and interact with children:

- **Force is a push (or a pull) that makes an object speed up or slow down.** Force is what causes an object to move. Notice when children are using a little bit of force or a lot of force to roll the bowling ball. **Summarize their discovery:** *You can control how much force you use to push the ball. The force of the ball is what makes the pins fall down.*
- **Bigger or stronger pushes can move things farther and faster.** Asking children to try different pushes (using different force) will give them an opportunity to explore this idea. Standing close and far from the pins will also help children explore this idea. **Summarize their discovery:** *We discovered that you need more force to hit the pins when you're standing far away. You don't need as much force to hit the pins when you're standing very close.*
- **Force is needed to move an object.** You might ask: If you don't roll the ball, will the pins still fall? What makes you think that? What can you do to make the pins fall? **Summarize children's discovery:** *It sounds like you've discovered that the force of the ball is what pushes the pins down.*
- **Pushing something moves it farther away from you.** You learned that pushing the balls makes it roll away. When the ball pushes the pins, the pins move farther away from the ball.
- **Once an object is moving, it travels in a straight line unless something gets in the way.** Point out how the ball rolls straight to the pins and bounces off the wall.

EXPLORE

ASK: Now, we're going to try a different kind of pushing and a different kind of ball. We're going to see if we can take our pom-poms on a race along this track.

Take out the four prepared box tops.

DEMONSTRATE: Place the pom-pom at the beginning of the track you've made. Blow through the straw to push the pom-pom down the line.

EXPLAIN: I was blowing with some force in order to push the pom-pom! Show me how you blow with force. Do you want to try?

TRY IT: Give each child a box top, a new straw, and a pom-pom. Encourage them to try blowing the pom-pom along the track. Once they have the hang of it, two children can come together to "have a race" by putting two pom-poms in the box lid at the same time.

ASK: Now let's experiment with force. What do you think will happen if you blow your pom-pom with just a **little bit of force**? (Afterward, ask: What did happen? What did you observe?) **Summarize children's discovery:** *When you blow with gentle force, the pom-pom doesn't move very far. Gentle force doesn't push the pom-pom very far.*

ASK: Now let's experiment with blowing through our straw with **a lot of force**! What do you predict will happen? (Afterward, ask: What did happen? What did you observe?) **Summarize children's discovery:** *When you blow with a lot of force, the pom-pom moves forward farther and faster. The stronger force pushes the pom-pom farther.*

TRY IT: Allow children to continue exploring the pom-pom track. They may try to blow without the straw or use their fingers to push the pom-pom—both approaches are fine. You can still explore the idea of pushes, force, and motion.

REFLECT

To close the activity, bring the children back together. Use a reflective question/s - like those below - to prompt children's thinking about force, motion, pushes, and collisions.

- What did you learn about pushes today?
- What do you think about this idea of force? Did you like pushing with a lot of force or a little force?
- What makes the ball (or the pom-pom) move?
- What did you discover about force and motion today?
- Tell me about how collisions work.

SUMMARIZE: Today we learned about force and pushes. We learned that by pushing with a lot of force, balls can roll farther and faster. Balls with a lot of force knock down more pins. By pushing with a little force, balls roll more slowly and not as far. Balls with a little force don't knock down as many pins. We also learned that pushes can happen with our hands, but that our breath can also push—because we pushed the pom-pom by blowing through the straw.

Individualizing the Activity

Make it more challenging:

- Have children keep a tally of how many pins they knock down each time they experiment with a different type of push (or force). This addition builds early math skills.
- You can also experiment by providing children with carpet squares or flattened cardboard boxes to roll the ball over when bowling. How does the ball react to these surfaces? Do you need more or less force to make it roll? You can review the role that *friction* plays in speeding up or slowing down a moving object (see Unit 16: So Slow).
- Instead of a straight course on your pom-pom track, you can draw a course with some diagonal/zig-zag lines that will require more controlled force when blowing in order to follow the track.

Make it less challenging:

- Use 3 plastic bottles for bowling, instead of 5. You might also use larger bottles (two-liter soda bottles) instead of smaller bottles.
- Assist children (as needed) in setting and re-setting their pins.
- Instead of having children blow through the straw, encourage children to push the pom-pom with their finger or push it with a plastic block they can hold in their hands.
- Focus on three key learning messages: (1) A push is needed to move an object away from you. (2) You can push with a lot of force or a little force. (3) The object you're pushing will move differently based on how much force you use.

MAKING CONNECTIONS ACROSS THE DAY:

- Add the homemade bowling game to your classroom activity options for free play.
- Talk about pushes and force when children want a push down the slide or on the swing. You can ask whether they want a push with a lot of force or a little force?
- Notice when you use a push to move objects across your day—for example, closing the classroom door, closet door, or bathroom door. Talk about how your push moves these objects.
- When children are playing with toy cars or trains, you can use the concept of force to redirect behaviors: *I need you to use less force. Try gentle pushes so you don't collide with Logan's train.*
- Play a freeze dance game where you play music and tell children they can be "in motion" and then stop the song and "stop their motion." This game helps children learn the word "motion" and also practice self-control.

Song: Collision

Model the movements for children and encourage them to do what you do!

Verse 1

What if you were a bowling ball rolling down the hall	(roll hands around each other)
Then you bumped into the wall...Collision!	(clap hands)
Would you go right through the wall,	(wiggle fingers forward)
Or just stop...not move at all?	(hand up to show "stop" and freeze)
Or would you change your direction?	(move pointed fingers at a diagonal)
The force of the collision pushed you in a new direction!	(pointing fingers at the diagonal)
The wall got in your way, so go another way!	(point in all different directions)

Interlude (spoken)

Did you know? Force is a push or pull that makes an object speed up or slow down.
We use force to push a bowling ball fast or slow.

Verse 2

So, push that ball really fast, and its momentum will last	(pretend to give a strong push)
Until the pins are knocked down in all directions!	
Or push that ball really slow and notice how it goes.	(pretend to give a gentle push)
Does it hit as many pins in the collision?	
The force of the collision pushed them in a new direction!	(Hold ten fingers up like pins)
Pins wobble, wobble, sway; they got knocked out of the way!	(wiggle fingers, "burst" from fists)

Interlude (spoken)

Did you know? A collision is when one thing bumps into another!
When a bowling ball hits the pins, it's a collision!

Coda

collision, collision, collision, collision...collision!	(free dance, claps)
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Making Literacy Connections

Share the following book with children as an opportunity to deepen their understanding of pushes, force, and motion. The literacy extension activity below suggests another play-based experience to explore the concept of pushes and force..

Suggested Book: *Oscar and the Cricket* by Geoff Waring

AS YOU READ:

- On the first page when Oscar finds a ball, ask the children what they think will happen if Oscar pushes it with his paw.
- On the page when the ball is rolling on the path, use your finger to trace the dotted lines. Ask children: Is the ball rolling straight? Or is the ball rolling in a crooked path? Then ask children where they think the ball is going (to the tree). What do they think will happen when it hits the tree?
- When the ball bounces off the tree, make the connection to the bowling game. When a ball is pushed while it's moving, it can change direction.
- The wind is an invisible force (on the page with the tree and its leaves). Ask children, when we had our pom-pom races, what made the pom-poms move? (Their breath—which is also an invisible force pushing the pom-poms.)
- When the book talks about how we can move without being pushed or pulled, ask children to make a movement.
- On the page when they meet the black kitten, ask the children: Which animal stopped the motion of the ball?
- On the page with all the action words (run, roll, jump, flutter), invite children to make these movements with you.

BUILD ON THE BOOK: FORCE FUN

Materials: 1 ball for every 3 children

Put children in groups of three and have them sit in a triangle, each child about a foot or two away from the others. Tell them that they will take turns acting out the different forces in the book. Give each group a ball. Begin by asking one child to START the ball moving to another peer. Then ask that peer to CHANGE the ball's direction and roll it to the third child in the group. Ask that child to STOP the ball's movement. You can then switch to using prompts about force: START AND USE FIRM FORCE or CHANGE AND USE GENTLE FORCE. Keep playing START, CHANGE, STOP for a few more rounds.

Handout 1: Examples of Collisions



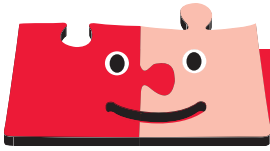


Learning About Push and Pull

This week, children are learning about force—which is the push or pull of an object that causes it to move. Have fun with push-and-pull at home using these activities:

- Make a homemade bowling game using a ball and 6 empty, plastic drink bottles. Place the bottles in a triangle (3 in the back row, 2 in the middle, 1 in front). Have your child stand a few feet away and roll the ball into the bottles.
 - See if your child can roll the ball with a gentle force. How many bottles are knocked down?
 - Can your child roll the ball with a strong force? How many bottles are knocked down this time?
- Take a ball to the park with your child. Kick or roll it back and forth to one another. You are using the force of your foot to kick the ball. You are also using the force of your foot or hands to stop the ball. Practice using a gentle force or a strong force to kick with—what happens to the ball each time?
- When you're outside with your child, notice how the wind can blow leaves, papers, and flags. We can't see the wind but we know it has a force that can push the things it touches.





Solo para familias

Aprender a empujar y halar

Esta semana, los niños están aprendiendo sobre esa fuerza que consiste en empujar o halar un objeto para que se mueva. Diviértanse empujando y halando objetos en casa con estas actividades:

- Haga un juego de bolos casero con una pelota y 5 botellas plásticas vacías. Coloque las botellas formando un triángulo (3 en la fila de atrás, 2 en el centro y 1 adelante). Haga que su hijo se coloque a unos metros de distancia y haga rodar la pelota entre las botellas.
 - Vea si su hijo puede hacer rodar la pelota con una fuerza suave. ¿Cuántas botellas se caen?
 - ¿Puede su hijo hacer rodar la pelota con una fuerza intensa? ¿Cuántas botellas se cayeron esta vez?
- Lleve una pelota cuando vaya al parque con su hijo. Denle patadas o háganla rodar mientras juegan entre ustedes dos. Están utilizando la fuerza de los pies para patear la pelota. También utilizan la fuerza del pie o de las manos para detener la pelota. Practique usando una fuerza suave o una fuerza intensa para patear: ¿qué le pasa a la pelota cada vez?
- Cuando esté al aire libre con su hijo, fíjese en cómo el viento puede mover hojas, papeles y banderas. No podemos ver el viento, pero sabemos que tiene una fuerza que puede empujar las cosas que toca.

