

Lesson Plan: I Like to Move It, Move It

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Target Grade: TK

Teacher Prep Time: 1 hour 30 minutes

Lesson Time: 2 hours 30 minutes (We recommend doing this lesson over 4 days, 1 part per day.)

- Part 0:
 - Provide students opportunities to play with Marble Run sets.
- Part 1:
 - 30 min – Moving Objects
- Part 2:
 - 20 min – Motion Stations
 - 20 min – Summarizing Findings
- Part 3:
 - 5 min – Curves and Obstacles
 - 15 min – Structure of Pieces
 - 15 min – Sloth and Fox Paths
- Part 4:
 - 15 min – Predicting Motion
 - 20 min – Play time
 - 10 min – Show and Tell

Where This Lesson Fits in:

This lesson would go at the beginning of a physical science unit that focuses on an object's motion. This lesson only focuses on changing the speed of an object from K-PS2-1 another lesson would need to follow that focuses on how to change the direction of motion.

Lesson Overview:

This lesson introduces and differentiates between a push and pull on an object and how changing variables affect the speed of an object. Students will apply what they learned to Marble Run structures and will discuss the structure and function of different specialty pieces. They will predict how the pieces will affect marble motion (slow down or speed up the marble relative to a reference piece). After testing the effects of single pieces, they will predict and rank the order in which a marble will run fastest through five structures with five specialty pieces each. The activity ends with students building Marble Run structures, describing how the speed of a marble will change as it is going through their structures, then releasing a marble through their structure to confirm their ideas.

Learning Objectives:

- Students will be able to identify key structures (weight of object, properties of the surface, or properties of the path), and the functions of these structures in terms of motion (speed up or slow down an object).
- Based on structural differences between Marble Run paths, students will be able to predict the relative speeds at which marbles complete the paths.



NGSS:

- **Performance Expectation**
 - K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
 - This lesson is in preparation for the kindergarten PEs above.
- **Science and Engineering Practice**
 - #6 Constructing explanations (for science) and designing solutions (for engineering)
 - Describing what happened (science)/ Tinkering (engineering)
 - Make inferences and form generalizations based on evidence.
 - Share findings and explanations, which may be correct or incorrect, with or without adult prompting.
- **Disciplinary Core Idea**
 - PS2.A Forces and Motion and PS2.B Types of Interactions
 - Pushes and pulls can have different strengths and directions, and can change the speed or direction of its motion or start or stop it.
- **Cross Cutting Concept**
 - #6 Structure and Function
 - Students observe the shape and stability of structures of natural and designed objects are related to their function(s).
- **Common Core State Standard**
 - [CCSS.ELA-LITERACY.SL.K.1](#)
 - Participate in collaborative conversations with diverse partners about *transitional* kindergarten topics and texts with peers and adults in small and larger groups.

Materials Needed (see start of lessons sequence for suggested students per group):

- (1 per student) Push and Pull worksheet
- Word Cards: push (7), pull (7), speed (7), slow (7), fast (7), distance (7), long (7), short (7), force (7), heavy (3), light (3), surface (3), smooth (5), rough (5), slope (5), flat (3), obstacle (3), curve (4), and straight (4). We laminated these cards so they can be used for multiple years.
- (1 per student + 12) Wooden cars (the additional 12 are for the weight station) - [Amazon \(https://smile.amazon.com/dp/B094NPTZJG\)](https://smile.amazon.com/dp/B094NPTZJG) This set comes with 2 each of 6 different cars. You will need cars with flat backs for the weight station. We used the cars below for the weight station cars.



- Sloth and Fox video
- (6) Smooth surfaces (ex: wood) ~2 ft x 1 ft: one smooth surface is used for the surface station and two smooth surfaces are used for the slope station. For the surface stations the smooth surface can be the wood on the table, if students are working on a table. For the slope station if you do not have wood you can use two large picture books.
- (2) Rough surfaces (ex: washcloth or hand towel) ~2 ft x 1 ft



- (2) Ramps - (can use stacks of books)
- (12) 35 mm Film Canisters. - [Amazon](https://smile.amazon.com/AKIRO-Canisters-Storage-Containers-Plastic/dp/B07XXN34JH/ref=sr_1_5) (https://smile.amazon.com/AKIRO-Canisters-Storage-Containers-Plastic/dp/B07XXN34JH/ref=sr_1_5). If the film canisters are opaque, you can mark the ones that are the same weight with a sticker so students can tell them apart.
- (¼ cup) Sand
- (1 per 3 students) Marble Genius - Marble Run Starter Kit (130 pieces) - [Amazon](https://www.amazon.com/Marble-Genius-Run-Starter-Set/dp/B01BEONPS4/ref=sr_1_5) (https://www.amazon.com/Marble-Genius-Run-Starter-Set/dp/B01BEONPS4/ref=sr_1_5).
- Specialty Piece Cards: Half Circle, Round' n Round, Wheel, Small Ladder, Ladder, and Straight
- Path Demonstration - tubing set up (6 ft of bilge pump discharge hose 1 ½ in diameter (Home Depot) cut into a 4 ft and 2 ft piece, wrapped around paper towels and held in place with rubber bands), and (1) pencil (see photos below)
- Class Data Table
- Timer
- Document Camera

Teacher Prep:

Part 1:

- Have word cards (push, pull, speed, slow, fast, force, distance, long, short) ready to use.
- Have a toy car for each student.
- Have the sloth and fox video cued up to show students.

Part 2:

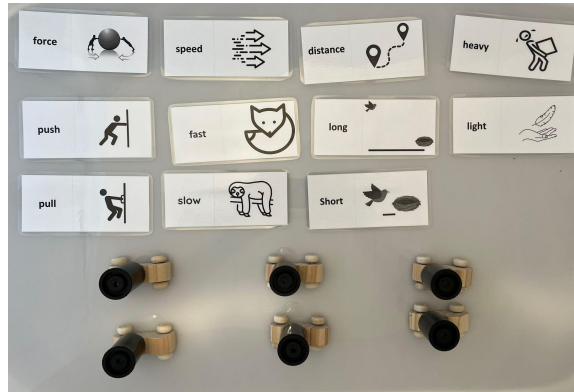
- Modify 12 wooden cars by using pliers to remove the sphere on the top of the car and gluing a film canister to the back. Fill four of the film canisters completely with sand, four halfway with sand, and leave four empty.



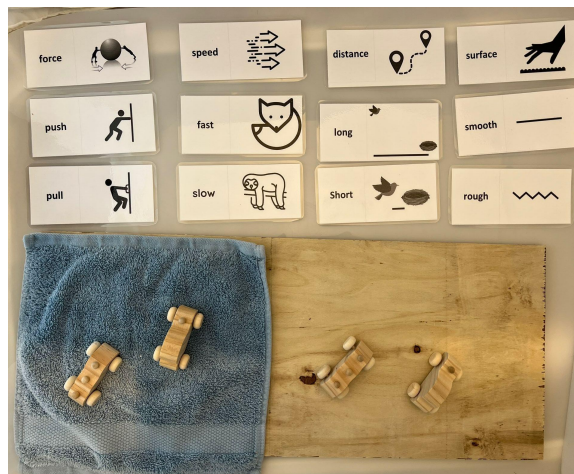
- Print *Push and Pull* worksheet.
- Have the word cards from part 1 on the board (push, pull, speed, slow, fast, force, distance, long, and short).
- Have word cards (heavy, light, surface, smooth, rough, slope, flat) ready to use.



- Set up two of each motion stations. This will allow students to rotate in groups of three or four.
 - Weight Station: 6 cars with film canisters glued to them (2 filled completely with sand, 2 filled halfway with sand, and 2 empty) and word cards (force, push, pull, speed, fast, slow, distance, long, short, heavy, light).



- Surface Station: 4 cars, 1 piece of wood (roughly 2 ft x 1 ft; if they are working on tables they can use the table as the smooth surface), one hand towel (roughly 2 ft x 1 ft), and word cards (force, push, pull, speed, fast, slow, distance, long, short, rough, smooth, fast, and slow).



- Slope Station: 4 cars, two pieces of wood (roughly 2 ft x 1 ft), 5 books, and word cards (force, push, pull, speed, fast, slow, distance, long, slope, flat).



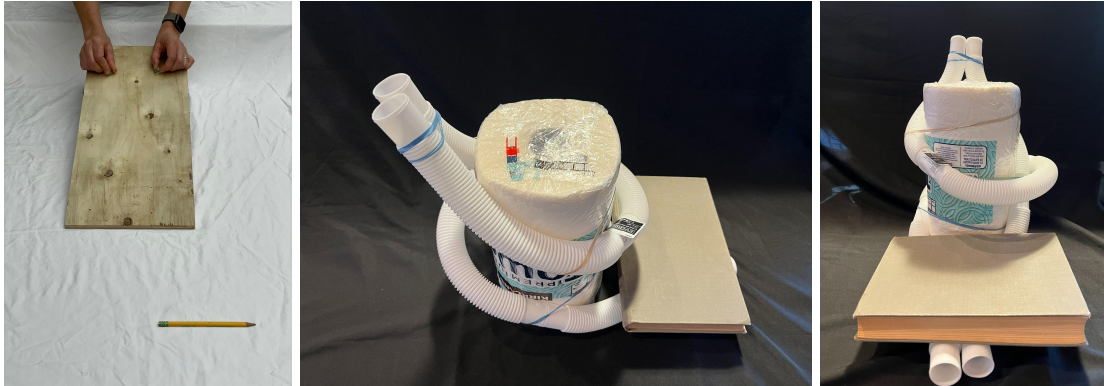
*Note: The two pieces of wood look like they are at the same slope, however, one is raised 2 inches and



the other is raised about 6 inches. You can also use large picture books instead of wood for the ramp.

Part 3:

- Have the word cards from parts 1 and 2 on the board (push, pull, speed, slow, fast, force, distance, long, short, heavy, light, surface, smooth, rough, slope, and flat).
- Have word cards (obstacle and curve) and specialty piece cards (Half Circle, Round' n Round, Wheel, Small Ladder, Ladder, and Straight) ready to use.
- Have extra wood cards to tape under specialty pieces cards (long (2), short (4), smooth (4), rough (2), slope (4), flat (2), obstacle (2), curve (3), straight (3))
- Prepare the obstacle and curve paths. Make sure that the obstacle path has enough slope to allow the marble to go over the pencil but not push the pencil.



- Build the following structures:





- Have an extra of each of the specialty pieces (Half Circle, Round 'n Round, Ladder, Small Ladder, Wheel, and Straight) to show students.

Part 4:

- Make a copy of the *Class Data Table*
- Have one set of Marble Run for each group of 3 students (4 Round 'n Rounds, 2 Ladders, 2 Half Circles, 4 Small Ladders, 2 Bases, 2 Big Arches, 3 Marbles, 4 Wheels, 51 Tubes, Small Arch, 3 Top Entries, 3 Straight Pieces, and a Large Base).
- Build the following structures (time in seconds):

Structure 1: (2 s)



Structure 2: (20 s)



Structure 3: (4 s)



Structure 4: (16 s)



Structure 5: (34 s)





Lesson Sequence:

* For this activity we recommend students work by themselves. In Part 2, they will rotate through stations in groups of 3-4 and in Part 4, they will share a Marble Run Set with 3 other students.

Part 0:

- Prior to doing this lesson, we highly recommend you allow students to play with the Marble Run sets. You can have these sets out at recess for students to play with so they become familiar with the pieces. If desired, during this time you can get students to build you the structures that you will use during the lesson.

Part 1:

30
minutes

Moving Objects

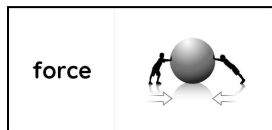
- Tell students, "Today we are going to explore the motion of objects."
- Pass out a toy car to each student and have them find different ways to move the car.
- Have students come to the front of the class and show what they found. Make sure they show both pushing and pulling the car. When they demonstrate **pushing** and **pulling**, put up the corresponding word cards.
 - If you would like, you can also introduce hand signals for push and pull.



- Ask students, "What do we mean when we talk about the speed of an object?"
 - ESR: How fast or slow something moves.
- Show students the video of the sloth and the fox and have them discuss the speeds of the animals.
 - Put up the **speed**, **slow**, and **fast** word cards.



- Have students give a few other examples of things which are slow and fast.
- Tell students, "Now that we know we can move an object by pushing or pulling it, I want you to play with your cars and figure out how you can change the speed of the car."
- Have students play with the cars to determine how to change the speed.
- Have students show and tell what they found.
 - ESR: Pushing or pulling the car harder makes it go faster and farther.
- Tell students, "The strength of the push or pull that you put into an object to make it go is known as the force. The larger the force the faster the object will move." Put up the **force** word card.



- Tell students, "Distance is the length of the path that the car travels." Put up the **distance** word card. "You are now going to play with your cars and see how the



force affects the distance the car travels.”



- Have students play with their cars to determine how force changes the distance.
- Have students show and tell what they found.
 - ESR: The more force I put into the car the farther it goes.
 - As students bring up the words **long** and **short**, add them to the word wall.



- Ask students, “Does it take more time to go a longer or a shorter distance?” By the end of the conversation, make sure students understand that it takes more time to go a longer distance.
- Have students summarize what they learned.
 - ESR: You can push and pull a car to make it go. The push or pull is called a force. The harder you push the car, the more force you are putting into the car and the faster the car goes. More force also allows the car to go farther. The farther something goes, the more time it takes.

Part 2:

20
minutes

Motion Stations

- Ask students, “What did we learn last session when we were playing with our cars?”
 - ESR: You can push and pull a car to make it go. The push or pull is called a force. The harder you push the car, the more force you are putting into the car and the faster the car goes. More force also allows the car to go farther. The farther something goes, the more time it takes.
- Tell students, “Today you are going to rotate through three stations and play with the cars at those stations to see how some other factors affect motion.”
- Show students one of the weight stations. Pick up two cars (making sure they are different weights) and have a student feel both cars and ask them, “How are the cars different?”
 - ESR: One car weighs more than the other.
- Tell students “At this station you will explore how weight affects the cars’ motion. The cars you will play with will either be heavy or light.” Add the word cards **heavy** and **light** to the board.



- Show students one of the surface stations. Ask them, “What does it look like you will be exploring here?”
 - ESR: Changing the surface. Put the **surface** word card on the board.



	- Ask students, "How are the wood and the towel different?" - ESR: The wood is smoother than the towel. - Add the word cards smooth and rough to the board. - Show students one of the slope stations. Ask them, "What do you think you will explore at this station?" - ESR: How tilted/sloped the surface is. - Make sure students know the words slope and flat and add these word cards to the board. - Tell students, "At each station, think about what will make the car go slow like a sloth or fast like a fox." - Assign each student a station to start at. Allow students 5 minutes per station to play with the cars and the materials and then have them rotate to the next station. Walk around and ask students questions to help them think about speed and force.
20 minutes	Summarizing Findings - Tell students, "We are now going to talk about each station, starting with the weight station. What did you learn about how weight affects motion?" - ESR: The heavier the car is, the more force is needed to make it go. If you give two cars the same force, the heavier car will go a shorter distance. - As students talk about what they observed, point to the relevant cards. - Tell students, "We are now going to talk about the surface station. What did you learn about how the surface affects motion?" - ESR: Smoother surface, like wood, takes less force to move the car than rough surfaces. If you give two cars the same force, the car on the smooth surface will go farther. - Tell students, "We are now going to talk about the slope station. What did you learn about how the slope affects motion?" - ESR: The steeper the slope, the faster the car goes, and the farther it will go after it comes off the ramp. This must mean steeper slopes give the car more force. - Make sure that students understand that steeper slopes must give the car more force. - Tell students, "You will now draw two pictures, one picture of a car moving fast and one of a car moving slowly." - Pass out the <i>Push and Pull</i> worksheet and have students draw their pictures. - Allow a few students to share their pictures with the class.

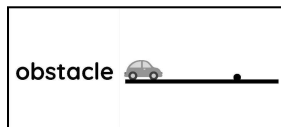


Part 3:

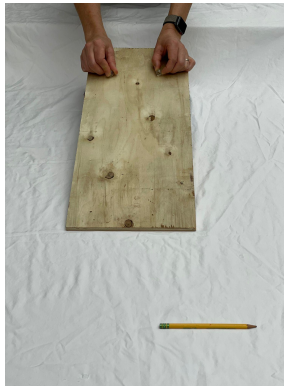
5
minutes

Curves and Obstacles

- Ask students, “What did we learn last session when we were playing with our cars?”
 - ESR: We learned the more weight the car has the more force you have to put into it to make it move. The smoother the surface the faster the car moves with the same amount of force. The steeper the slope the faster the car moves.
- Tell students, “We are now going to explore two other factors that might affect motion and we will use what we learned last time to predict what will happen if we race two marbles.”
- Tell students, “We will first explore what happens when an obstacle is in the path.” Ask students, “What is an obstacle?”
 - ESR: It is something that is in the way of the marble.
 - Put up the **obstacle** word card.



- Show students the path with the obstacle and the path without the obstacle.



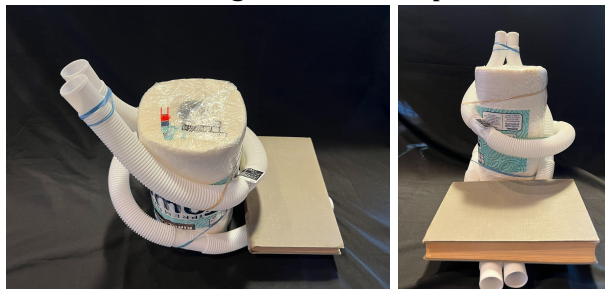
- Ask students, “When I roll a marble down a path with an obstacle and a path without an obstacle, which marble will get to the end faster, and why?”
 - ESR: The marble that does not have an obstacle will get to the finish line first because an obstacle is like a really rough surface, and the rougher the surface, the slower the car.
 - Make sure students relate the obstacle to a rough surface.
- Race the two marbles down the setup and confirm the students’ predictions.
- Tell students, “We will now explore the curve of the path.” Ask students, “Does anyone know what a curve is?”
 - ESR: How bent the path is.
 - Put up the **curve** and **straight** word card.



- Show students the straight and curved setup and tell them, “We are now going to



roll two marbles down the straight and curved paths.”



* We had to put a book on the end to keep the pipe down.

- Ask students, “When I roll a marble down the curved path and the straight path, which marble will get to the end faster and why?”
 - ESR: The marble that goes on the straight path will get there faster because the distance is longer for the curved path.
 - Make sure students relate the curved path to a longer distance.
- Race the two marbles down the setup and confirm the students’ predictions.

15
minutes

Structure of Pieces

- Tell students, “We will now apply what we have learned over the course of this activity to determine key features of structures and then determine if the structure will make the marble travel fast or slow. We will compare all the structures to a structure with a Half Circle piece.”
- Show students the structure and point to the Half Circle piece. Tell students, “All the structures that we compare will be the same except I will trade the Half Circle piece (hold up the piece) for another specialty piece.”



- While holding the Half Circle, tell students, “The words on our word wall can help us define key structures about the pieces. For instance, a piece could be rough and straight.”
- Put up the Half Circle path card and tell students, “We are going to go over the key structures in this piece. For example, this piece is going to be considered short.” Take a short card and tape it under the picture of the Half Circle. Ask students, “What other cards can be used to describe this piece?” Have students use the word wall and describe the Half Circle as they find descriptors, tape an



extra of these cards under the picture of the Half Circle. Once all the pictures are there, have one student describe the piece in a sentence. Using the sentence frame “The structure of this piece is ____.”

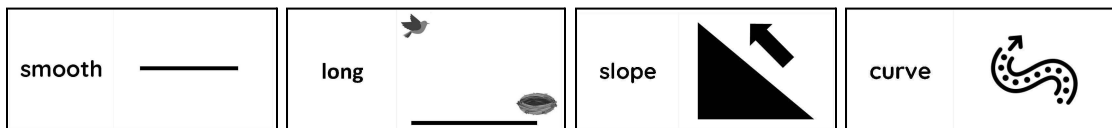
- Note: You must give them the descriptor of short. Short and long are relative so they will need to know what they are defining as short to reference the other pieces to.
- ESR: The structure of this piece is short, curved, smooth, and flat.



- Tell students, “I will now show you the other pieces and we will determine the key structures.”
- Put up another special function path card, hold up the matching piece, and have students identify the structural differences and use the sentence frame. “The structure of this piece is ____” to describe the piece.

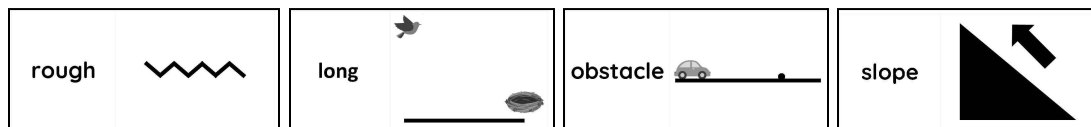
- Round ‘n Round

- The structure of this piece is smooth, long, slightly sloped, and curved.
- You might need to have them think about the path the marble will take and describe the motion while you use your finger to show the path is long.



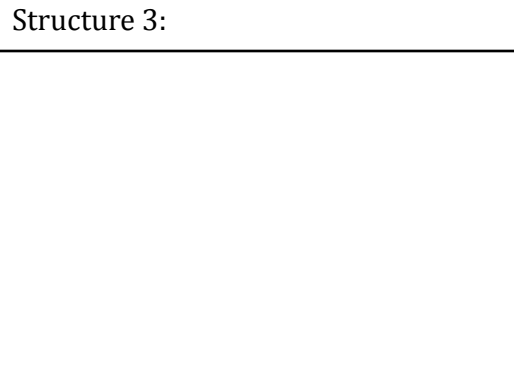
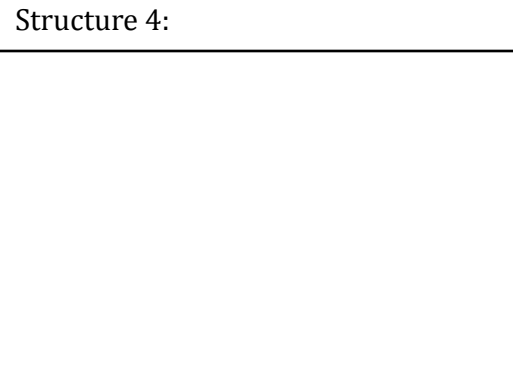
- Ladder

- The structure of this piece is rough, long, obstacle, slightly sloped, and straight.



	○ Small Ladder ■ The structure of this piece is rough, short, slightly sloped, and straight. ○ Wheel ■ The structure of this piece is smooth, short, has an obstacle, sloped, and curved. ○ Straight Piece ■ The structure of this piece is smooth, short, flat, and straight. ● Tell students, “Now that we know the key structure differences between these pieces we are going to determine if they are slow pieces like sloths or fast pieces like foxes.”
15 minutes	Sloth and Fox Paths ● Tell students, “We are going to look at each of the specialty pieces and determine if the function of the pieces is to speed it up or slow it down compared to the Half Circle piece and why it functions this way. Then we will race the Half Circle structure and the other structures to see if we are right. ● Hold up one specialty piece and have the class identify if it is a sloth or fox piece by using the following sentence frame. ○ The function of the (insert chosen piece) is to ____ because ____. ■ The function of the Straight Piece is to speed up the marble



	because it goes in a straight path. ○ When choosing which structure to use next, try to go from easiest to hardest. Some structures have multiple changes which could go in opposing directions. Suggested order: Straight Piece, Round 'n Round, Small Ladder, Ladder, and Wheel. ○ Example for the Wheel: The function of the Wheel is to speed up the marble because it is more sloped. Note: students could also say, the function of the Wheel is to slow down the marble because the piece has an obstacle. ● Once the class has shared their ideas, perform the race. ● Tell students, "Tomorrow we are going to look at structures with multiple special function pieces in them and see if we can arrange them from slowest to fastest."
Part 4:	
15 minutes	Predicting Motion ● Ask students, "What did we learn last time about each of the special function pieces compared to the Half Circle piece?" ○ Hold up the Half Circle piece and one other piece and have students tell you if it is a sloth or fox piece and why. ○ Possible student response for the Wheel: the Wheel is a fox piece because it is more sloped than the Half Circle. ● Tell students, "Today we are going to make a prediction about how fast a marble will go through each of these structures (point to the structures). Let's put the structures in order from slowest to fastest." Structure 1:  Structure 2:  Structure 3:  Structure 4: 





Structure 5:



- Have students arrange the structure from slowest to fastest and tell you why they think the order is correct.
- Fill out the predicted order on the *Class Data Table*.
- Time how long it takes for the marble to complete each path and record that on the *Class Data Table*.
 - You should get approximately these times for the structures:
 - Structure 1: 2 s
 - Structure 2: 20 s
 - Structure 3: 4 s
 - Structure 4: 16 s
 - Structure 5: 34 s
- Rearrange the structures in the actual order of slowest to fastest.
- Have students compare the structures that allowed the marble to complete the path quickly and slowly and identify patterns. Some of the patterns they may notice are:
 - Structures with Round n' Rounds took longer for the marble to complete the path.
 - Structures with short pieces took shorter times for the marble to complete the path.

20
minutes

Play Time

- Tell students, "Now it is your turn to play with the Marble Run sets. You are going to get 15 minutes to build a structure. While you are building your structure, try to think about what parts of your structure the marble will go through quickly and which parts it will go through slowly."



	• Give each group of three students one Marble Run set. Make sure each student in the group gets one base (either Base or Large Base), one Top Entry, and one marble. • While students are building structures, go around and ask them questions about how parts of their structure might affect the speed of the marble. • After 15 minutes are up, have students tell the other students in the group of three where the marble will go fast and slow through the structure and why they think this. Then allow them to run a marble through their path.
10 minutes	Show and Tell • Have two students bring their structures to the front of the class. Have each student point out one area the marble will go fast in and one area the marble will go slow in. Then, as the class, predict which structure will allow the marble to finish in a faster time. Once students have shared their thoughts, race marbles through the two structures to see if they were correct. • Repeat the process with two new students but this time have them predict the structure that will have the slowest time to complete the run. • Repeat the process a few times. • End the lesson by having students explain what they have learned. ○ ESR: You can move objects by pushing or pulling them. The more force you put into an object the faster and farther it goes. The heavier the object the slower and shorter it goes. The smoother the surface the faster and farther the object goes. If the path is shorter, not curved, and has no obstacles the object will travel faster.

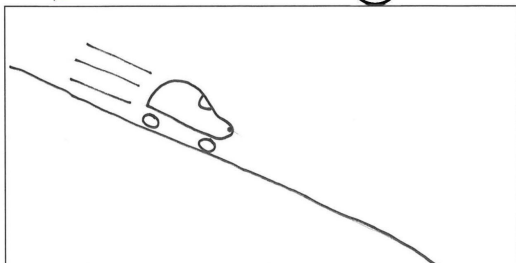
Example Student Work and Class Data Table:



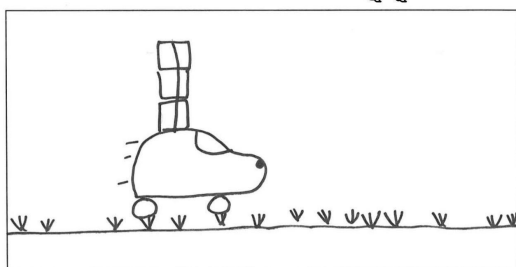
Name: Janis

I Like To Move It, Move It Pushes and Pulls

Draw  a car that is moving fast .



Draw  a car that is moving slow .



Class Data Table

Structure	Pieces Used		Predicted Order	Time	Actual Order
1			1	2 s	1
					
2			4	20 s	4
					
3			2	4 s	2
					
4			3	16 s	3
					
5			5	34 s	5
					

