Patterns in Motion

3.3

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Anchoring Phenomenon

Objects move in different ways during physical activities on the playground.

Lesson Concept

Analyze and interpret data to determine patterns and cause and effect to predict the motion of a soccer ball based on force strength and to apply the data to an engineering design.

Investigative Phenomenon

A kicked soccer ball on the playground didn't make it all the way into the goal.

Standards

Refer to Appendix 3.3 for NGSS, CCSS—ELA and Math, and California ELD standards.

Storyline Link

In Lesson 2: Forces Move Objects, students created models to show balanced and unbalanced forces based on knowledge gained through basketball experiences. Students investigated the effect of strength and direction on the speed and distance traveled by the basketball.

In this lesson, students build on these fundamental understandings of force and motion and apply them to a soccer ball. They analyze and interpret data about how the strength of the force impacts the distance the soccer ball moves. They apply the patterns of motion to predict team players and their success for a new soccer game for the new playground. In the next lesson, students continue to think about balanced and unbalanced forces as well as strength and direction as they complete a tug-of-war activity.

Throughout the unit, a flag (▶) denotes formative assessment opportunities where you may change instruction in response to students' level of understanding and making sense of phenomena or solving a problem.

Time

4 hours 45 minutes

Part I	30 minutes	Engage
Part II	45 minutes	Explore 1/Explain 1
Part IIIa	60 minutes	Explore 2/Explain 2
Part IIIb	45 minutes	Explore 3/Explain 3
Part IV	45 minutes	Explain 4
Part V	60 minutes	Elaborate/Evaluate

Materials

Whole Class

- ❑ Soccer ball(s) (or kickball)
- ❑ Soccer goal(s) (or two orange cones)
- ❑ 3.1.C2: Soccer (from Lesson 1: Movement on the Playground)
- ❑ 3.1.C3: Tug-of-war (from Lesson 1: Movement on the Playground)
- ❑ 3.3.C1: Class Data
- ❑ 3.3.C2: Even Chart

Groups (Groups of 3)

- ❑ Whiteboard and markers
- ❑ Poster board and markers
- ❑ Math counting manipulatives

Individual

- ❑ Science notebook
- ❑ 3.3.H1: Coach's Notes
- ❑ 3.3.H2: Data Table
- ❑ 3.3.H3: Even Table

Teacher

- ❑ 3.3.R1: Line Plot Example
- ❑ 3.3.R2: Possible Teams Combinations
- ❑ 3.3.R3: Evaluation Rubric
- ❑ TalkScience resource (http://stemteachingtools.org/assets/landscapes/TalkSciencePrintable.pdf)
- ❑ Women's Soccer video (https://www.youtube.com/watch?v=rz1-SOk8PfE)
- ❑ Men's Soccer video (https://www.youtube.com/watch?v=OmKbGOARXao)

Advance Preparation

1. Gather materials and make a copy of **3.3.H1: Coach's Notes**, **3.3.H2: Data Table**, and **3.3.H3: Even Table** for each student.
2. Make large charts of **3.3.C1: Class Data** and **3.3.C2: Even Chart** or use them with a document camera.
3. Prepare a chart page with the title Soccer Ball Movement Prediction.
4. Have ready **3.1.C2: Soccer** and **3.1.C3: Tug-of-war** (from Lesson 1: Movement on the Playground).
5. Review TalkScience resource: (http://stemteachingtools.org/assets/landscapes/TalkSciencePrintable.pdf) to determine when best to use this resource in student-to-student discourse.
6. Review **3.3.R1: Line Plot Example**, **3.3.R2: Possible Teams Combinations**, and **3.3.R3: Evaluation Rubric**.
7. Review these videos to see an example of a 4-touch soccer goal: Women's Soccer video 0:17–0:27 or 1:54–2:04 and Men's Soccer video 0:48–0:55.

Procedure

Part I

Engage (30 minutes)

Communicate information about how unbalanced forces move a basketball and how the same cause and effect can predict movement in a soccer ball.

1. Have students work in pairs to review their evidence from their science notebook about why a basketball sitting on a person's hand doesn't move and what has to happen to make it move.

   Expected Student Responses (ESRs):

   - *I learned that there are many forces acting on the basketball.*
   - *I learned that a basketball sitting on my hand doesn't move because all the forces around it are even. But if I drop my hand, the forces are not balanced, and the force (gravity) pulls the ball to the ground.*
   - *I learned when I throw the ball, I unbalance the forces to make it move.*
   - *If I throw hard, that is pushing the ball, and the ball will go farther.*
   - *From my evidence, I learned that other forces can change the direction the ball moves by pushing or pulling it.*

2. Show the students a soccer ball. Conduct a brief conversation about how soccer is played. Review **3.1.C2: Soccer** (from Lesson 1: Movement on the Playground). Ask, "What were some of our questions and wonderings we hope to answer today?"

> TEACHER NOTE
>
> If your students do not know about soccer, explain the game to them by showing one of the video clips of a soccer game (Step 7 in Advance Preparation) so that they understand the game.

3. Have student pairs discuss what they can predict about how a soccer ball moves compared to how a basketball moves. Have several partners share their ideas and chart their responses on **3.1.C2: Soccer**. *ESRs:*

   - *They are both balls, so I think if the soccer ball is just sitting there, it will not move (just like the basketball did not move) when the forces are balanced.*
   - *I think the soccer ball will move, speed up, or change direction when the forces are unbalanced.*
   - *In basketball, we use our hands to unbalance the forces to move the ball, and in soccer, we use our feet to do the same thing.*
   - *In basketball I push with my hands; in soccer, I push (kick) with my feet. In both, I unbalance the force to make the ball move.*

- *Just like in basketball, if I push the soccer ball harder, it will go farther.*
- *In both soccer and basketball, I can change the direction of the ball's movement by pushing or pulling it.*

4. Review **3.1.C2: Soccer**, focusing on what the predicted movement of the soccer ball was and how it would happen.

Part II

Explore 1/Explain 1 (45 minutes)

Make observations to determine the types of data and patterns that are needed to design a new soccer game.

5. Remind students that they will be working on designing the new playground. Tell them, "Yesterday we worked on making a prototype for the basketball game using ping-pong balls. Today we are going to be working on a soccer prototype. Space will be limited for soccer, so the new soccer game is called touch soccer. In this game, four players must pass the ball in order to get it into the goal. Each person can only kick a certain distance."
6. Ask the students, "Using what you know about forces and movement, what data would you need to collect to design this new game?" Give students 30 seconds to think to themselves. Then have students pair-share their ideas. Select a few students to share with the class. Chart their ideas. *ESRs: How big is the field? How far can each person kick? Can they kick in any direction they want? How many defenders will try to get the ball away from the player?*
7. Explain to students that they will have an opportunity to try out this new game. Remind students they will be in teams of four. Their job is to pass the ball to each person once (for a total of four touches) before the ball is kicked into the goal. They will try the game several times and then will return to the classroom to add to their list of data they need to analyze to create the game for the new playground.

TEACHER NOTE

Set up two or three different soccer goals. Place each soccer ball in a different location 50 feet from the goal. If you don't have a soccer ball, a kickball will work. If you don't have a soccer goal, you can use two orange cones, two small trash cans, two brightly colored sticks, or anything else to create goalposts for the students to kick the ball between.

8. Go outside with the students. Ask one group to play the game while the other students watch. Have the kicker start at the 50 feet mark and as a team of four, move the ball to the goal marks. Tell observers to watch for use of strength, direction, and balanced and unbalanced forces.
9. Allow all groups to play, reminding students to think about what other data they will need to analyze before they can engineer the new game.

10. Bring students back into the classroom and have teams debrief their play. Ask them to consider what additional data they need to add to their chart. Add to the chart as they share. *ESRs:*
    - *What is the amount of force each person needs to do for four touches to go into goal?*
    - *How does the change in direction affect the distance the ball has to go to reach the goal?*
    - *Is the movement better if each player balances the forces on the ball by stopping it before they kick, or should they kick it when it is still moving?*
    - *Does it matter in what order the players move the ball?*
    - *How can we draw a diagram that will show the movement of the ball?*

Part IIIa

Explore 2/Explain 2 (60 minutes)

Represent data in tables to find patterns in the strength of a kick (force) on the soccer ball.

11. Say to the class, “In order to determine the engineering design for the new soccer game, we need to gather data. One of the questions we wanted to answer was, ‘What is the amount of force each person needs to make four touches into the goal?’”
12. Distribute **3.3.H1: Coach’s Notes**. Explain that this data came from a coach who tested 18 players about how far they can kick a soccer ball that is on the ground and not moving. Each player was given 3 chances to kick the ball.
13. Have student pairs discuss what they think they should do with this data and why. Have a couple of partners share. Listen for students’ ideas about organizing the data so that it is easier to understand. Ask students to determine good ways to organize the data. Hopefully, students will say to put the data into a table.

> **TEACHER NOTE**
>
> If this is the first time students are converting raw data into a table, model how to create a table with a title and labeled columns. In this case, the labeled columns are: name, distanced (yards) traveled in kick #1, distance (yards) traveled in kick #2, distance (yards) traveled in kick #3.

14. Distribute **3.3.H2: Data Table**. Divide the list of 18 players into groups of 3 players (i.e. 1–3, 4–6; 7–9; 10–12; 13–15; 16–18) and assign one group of 3 to each set of partners. It is ok if there are multiple assignments to the same group. Have partners complete their **3.3.H2: Data Table** using **3.3.H1: Coach’s Notes** for their players.

TEACHER NOTE

Alternatively, have students create their own data table to enter the data. Then select a few to put under the doc camera to discuss the variety of formats, entries on the data table, and what the tables reveals about patterns.

15. Display **3.3.C1: Class Data** on the document camera and ask different partner groups to fill in the data for their players. Ask the rest of the students to complete their **3.3.H2: Data Table**, using the data on the class chart. If there are several groups working on the same people's data, ask probing questions to make sure their data entries are the same.

16. Conduct a discussion about **3.3.C1: Class Data**. Ask these questions for student discussion:

- "How easy is it to find patterns in what is displayed in the table?"
- "Which of the three kicks should we use? Why?"
- "Will that person kick the same way every time?"
- "If the person was allowed a fourth kick, how far do you predict the ball would go? Why?"

TEACHER NOTE

This discussion is trying to give students an intuitive sense of what an average is. Averaging is a sixth-grade CCSS, and third graders are not expected to calculate it. However, in real life, they have probably heard the term (e.g., in sports) and through a discussion of analyzing data, students can understand that they could "even" up the kicking distances.

17. Distribute **3.3.H3: Even Table**. Continue with the same groupings as in Step 14. It is ok to have multiple partners looking at the same kickers. Give partners math counting manipulatives and ask them to put the length kicked by each person into a pile, and then "even" the three piles. Have them enter the number on the "even" column on **3.3.H3: Even Table**. Then call on partner groups to enter their data on **3.3.C2: Even Chart** on the document camera. As students enter their data, ask other students to complete their **3.3.H3: Even Table**. If there are several groups working on the same people's data, ask probing questions to make sure their data entries are the same.

TEACHER NOTE

If students don't understand, work an example with them:

Miquel kicks 20 feet, 19 feet and 18 feet. To make them three lengths even, you can take one of the 20 math counting manipulatives and put it on the 18 pile. Now all three piles are even, so the number in the "even" column would be 19.

The answers are in the "average" column on **3.3.R2: Possible Team Combinations**.

18. Use **3.3.C2: Even Chart** to ask students: “What patterns do you see in the “even” column? Why are there differences in the distances the ball traveled? (Some people kicked with a stronger force). Why is the “even” number an important data point?” *ESR: You can predict that a strong force will move the ball farther, but it is hard to predict the exact distance—the “even” number gives an approximate distance.*

TEACHER NOTE

This discussion is important for students to understand the importance of conducting multiple trials. Scientists will look for patterns in the data collected. Patterns can be used as evidence to support an explanation.

Part IIIb

Explore 3/ Explain 3 (45 minutes)

Represent data in a graph to find patterns in the strength of a kick (force) on the soccer ball.

19. Ask students if they know a better way to display the data that might show the patterns more easily. Hopefully, they will suggest graphing. If not, explain that scientists graph data to find patterns.
20. Ask table groups to use their whiteboards to graph their data and look for any patterns. Circulate to monitor students as they complete the line plot.

TEACHER NOTE

If students have little experience with graphing, it is important to take the time here to discuss different types of graphs (e.g., bar, line, pie, line plots) and help students understand that this data is best displayed as a line plot because it is comparing categories (yards the ball traveled and the number of people who kicked that far).

See **3.3.R1: Line Plot Example**. Model setting up the graph with a title and labeling the axis, etc. For this graph, the horizontal axis (the x-axis) is labeled with the number of yards the ball traveled and the vertical axis (the y-axis) is the number of people who kicked at that distance.

21. Select table groups to display their graph and explain any patterns that they noticed. “How does the pattern indicate a relationship between the strength of a force and distance the ball travels?” If a pattern was already mentioned, ask the group to find another pattern or share something else that was interesting on the graph. *ESRs: no one kicked less than 8 yards; no one kicked more than 23 yards; the distance that the most number of people kicked was 19 yards—4 people could do that.*

22. Ask partners to summarize what they learned by creating a data table and graphing the data to explain force and motion. Have several partners share their ideas. Then ask each student to write their idea(s) in their science notebook. *ESRs:*
    - *Putting the data in a table made it more organized.*
    - *Graphing the data showed some patterns as to who could kick certain distances.*
    - *I knew that to move the soccer ball, people had to unbalance the forces by kicking (pushing) the ball.*
    - *I knew the harder the person kicked (the more strength of the force) caused the ball to travel farther.*
    - *I knew if the kick was a weak force, the ball didn't travel as far.*
    - *I predicted that a ball that traveled a shorter distance was caused by a weaker kick.*
    - *I predicted that a ball that traveled farther was caused by a stronger kick.*
    - *Not everyone kicked the ball as hard so the ball traveled different distances.*

Part IV

Explain 4 (45 minutes)

Analyze and interpret patterns in data to predict how to play the game using logic and mathematics.

23. Now that the students have some understanding about force on the motion of a soccer ball as well as how to predict its movement, they are ready to try a prototype design for the new touch soccer game. Tell students," The field size of a soccer field for 9 year olds might be 40 yards long. Your challenge is to select 4 players for your team. These are the rules:
    1. Start at the end line (the line on the opposite side of the field) and get the soccer ball to the goal.
    2. Use 4 players listed on **3.3.H1: Coach's Notes** and assume they will kick their 'even or average' distance.
    3. Create a least one change in direction.
    4. The ball will start not in motion (balanced force).

TEACHER NOTE

The shortest distance between two points is a straight line. Any path that is not a straight line (has a change of direction) is more than the distance to the goal. Students should focus on how to select the teams that can kick more than 40 yards to accommodate the change in direction; for example, they may need to kick a total of 50 yards to complete the task.

See **3.3.R2: Possible Team Combinations** as an example of possible teams to kick at 50 and 70 yards. These are not the only combinations that work.

24. Working in table groups of four, have students discuss, “Who would you select to be on a team? Why did you choose them? What can you predict about how the ball will be kicked?”
25. Ask table groups to draw on a whiteboard the movement of the ball using the size of arrows to denote the strength of the kick (force) from person to person and into the goal. Have them discuss if the order of the kickers matters or if the direction of the kick matters. What is their evidence for their decisions?
26. As students work, walk around the room, and select several tables to share their plan with the whole class. Pick different team selections and different strategies so that students can compare plans. As table groups share, have other table groups listen and ask questions about the plan. After each group shares, have the class determine what is similar and what is different in the plans. Make sure to explore these ideas: Does the order of the kickers matter and "How does the change of direction affect the distance."
27. Conduct a whole-class discussion using these questions: “What were important patterns of movement to consider in deciding who to put on the team? What patterns of strength were important to reach the goal? What patterns of less-strong kicks were evident? Why do these patterns matter?” *ESRs:*
    - *We had to look for a pattern in how the force moved the ball (how far people kicked the ball).*
    - *The pattern had to contain either a combination of all strong forces (kickers), or some strong and some not so strong.*
    - *If the pattern was only less-strong forces (kicks), we couldn’t reach the goal.*
    - *Patterns matter to predict the best team.*
    - *Cause and effect make up the patterns—if the player uses a strong force when kicking, the ball will go farther; the player uses a weak force when kicking, the ball will not travel as far.*
    - *Predictions help determine the team, but the players might not do what was predicted.*

Part V

Elaborate/Evaluate (60 minutes)

Communicate information about how the cause and effect of the strength of forces can be predicted and used to design a new soccer game.

28. Tell the whole class, “Good news! The new playground will provide for a soccer field that is 70 yards rather than 40. And there is a new rule. The ball needs to reach the goal which is 70 yards from the end line only this time without a change in direction. You also want the ball to just get to the goal line—not past the goal line. Working with a partner, determine if and how this changes who is on a team and why it matters.”
29. Have partners share at their table, and then have several tables share their ideas. *ESRs:*
    - *We need to select players who can provide a strong force when kicking the ball.*
    - *We must look at the data to find a pattern in the kickers and predict that a certain combination will move the ball exactly 70 yards.*

- *Patterns matter to predict the best team.*
- *Cause and effect make up the patterns—if the player uses a strong force when kicking, the ball will go farther; the player uses a weak force when kicking, the ball will not travel as far.*

30. Tell students that as an engineer, they will need to apply the claims and evidence that science provides for their design. Explain that when scientists observe patterns in data, they can make a claim that answers a question. Our question is: “How much force is needed in 4-touch soccer to get the ball into the goal?”
31. Based on their data from the players, their prototype teams for the 40-yard game, and their ideas for the 70-yard game, pose this question: “What claims can you make about the science behind force and motion of a soccer ball?”
32. Ask students to individually write a claim in their science notebook. *ESRs:*
    - *A greater force is needed to kick the ball a farther distance.*
    - *A combination of forces (kicks) is needed to get the ball into the goal whether the goal is 40 or 70 yards away.*
    - *If there is a weak kick (lesser force), the ball will not roll as far.*
    - *I can predict the movement of the ball based on the strength of the force. A weak force doesn’t move the ball far; a strong force makes the ball move farther.*
33. Have students share their ideas in the table groups.
34. Then tell the class, “Newsflash! The soccer field can now be 80 yards, and there can be different rules (e.g., a 5-touch game). Ask the table groups to:
    - write the rules of their game.
    - select a team that can accomplish making a goal and explain why you choose those players.
    - draw a diagram of the possible plan using your five players.
    - describe the execution of their plan in terms of balanced and unbalanced forces; strength of force; changes in direction; and how motion can be predicted.

Sample student work:

We predict we will need the strongest kickers.

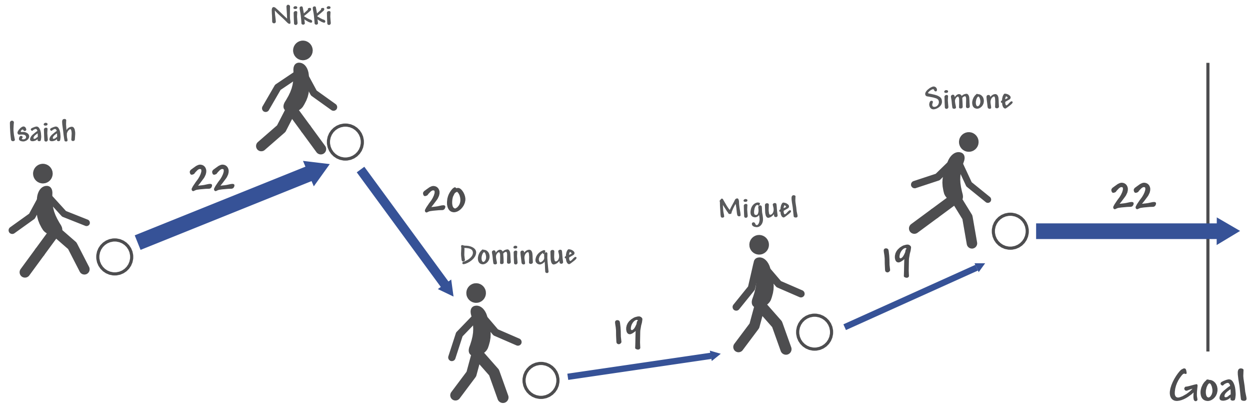
Possible players

Isaiah	22 yards
Nikki	20 yards
Simone	22 yards
Miguel	19 yards
Dominque	19 yards
	102 yards

Rules for 5-touch:

- Use 5 players, each who touches the ball once.
- The ball must change direction at least once
- The total yards the ball travels can be more than 80 yds but not less than 80 yds.
- The ball starts at rest—the forces are balanced.

Goal: Needs 5 players who can kick (unbalanced force) the ball with greater strength to make it go further. The ball starts at rest (balanced force). The five kicks (unbalanced force) must add up to more than 80 yards with the changes in direction.



Position of players to achieve the ball traveling more than 80 yards with the change in direction along with a change in motion.

Considerations

- Use the rules we stated—strength of the forces causes the ball to go farther
- Need a field that is about 80 yards long, but because of change the direction, our ball just needs to go over 80 yards. The field can be narrow but still allow the ball to change directions.

35. ▶ Have table groups share their ideas. Use **3.3.R3: Evaluation Rubric** to evaluate/assess how they applied their understanding of analyzing data, force and motion, cause and effect to their new game rules.
36. Close this lesson by referring the class back to the **3.1.C2: Soccer** chart. Have students identify any wonderings/questions for which they now have explanations.
37. Ask the class to share any new wonderings they would like to add to **3.1.C3: Tug-of-war** chart for their next investigation. Add any questions that will help them gather evidence for their final design for the new playground or further their understanding of movement on the playground.

Toolbox Table of Contents

Class Data

	Player	Yards Traveled			
		1st Kick	2nd Kick	3rd Kick	
1	Keaton				
2	Emmet				
3	Miguel				
4	Sierra				
5	Juan				
6	Dominque				
7	Ori				
8	Athena				
9	Bo				
10	Isaiah				
11	Erin				
12	Nikki				
13	Charly				
14	Gabby				
15	Oliver				
16	Simone				
17	Jesse				
18	Antonio				

Even Chart

	Player	Yards Traveled			
		1st Kick	2nd Kick	3rd Kick	Even Pile
1	Keaton	12	12	12	
2	Emmet	15	13	20	
3	Miguel	20	19	18	
4	Sierra	12	9	12	
5	Juan	11	13	15	
6	Dominque	16	20	21	
7	Ori	11	10	9	
8	Athena	15	10	11	
9	Bo	10	10	13	
10	Isaiah	20	22	24	
11	Erin	15	18	16	
12	Nikki	22	18	20	
13	Charly	10	13	16	
14	Gabby	16	16	16	
15	Oliver	10	11	12	
16	Simone	24	20	22	
17	Jesse	11	9	10	
18	Antonio	14	15	16	

A project of CA NGSS K–8 Early Implementation Initiative.

Coach's Notes

Keaton: 12, 12, 12; Emmet 15, 13, 20; Miguel 20, 19, 18;

Sierra 12, 9, 12; Juan 11, 13, 15; Dominique 16, 20, 21;

Ori 11, 19, 9; Athena 15, 10, 11; Bo 10, 10, 13;

Isaiah 20, 22, 24; Erin 15, 18, 18; Nikki 22,18, 20;

Charly 10, 13, 16; Gabby 16, 16, 16; Oliver 10, 11, 12;

Simone 24, 20, 22; Jesse 11, 9, 10; Antonio 14, 15, 16;

Class Data

	Player	Yards Traveled			
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1	Keaton				
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8	Athena				
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11	Erin				
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Even Table

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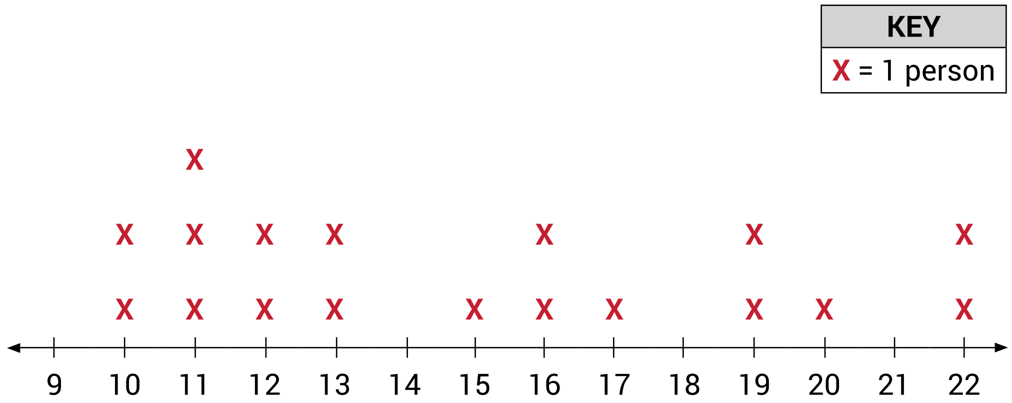
6	Dominque	16	20	21	
7	Ori	11	10	9	
8	Athena	15	10	11	
9	Bo	10	10	13	
10	Isaiah	20	22	24	
11	Erin	15	18	16	
12	Nikki	22	18	20	
13	Charly	10	13	16	
14	Gabby	16	16	16	
15	Oliver	10	11	12	
16	Simone	24	20	22	
17	Jesse	11	9	10	
18	Antonio	14	15	16	

Line Plot Example

Average Yards Kicked Ball Traveled



Possible Team Combinations

Player		Yards Kicked							
		1st Kick	2nd Kick	3rd Kick	TOTAL	AVERAGE	70-yard game	Average	40-yard game
1	Keaton	12	12	12	36	12		12	51
2	Emmet	15	13	20	48	16	70		
3	Miguel	20	19	18	57	19			
4	Sierra	12	9	12	33	11		11	
5	Juan	11	13	15	39	13		13	
6	Dominque	16	20	21	57	19			
7	Ori	11	10	9	30	10		10	
8	Athena	15	10	11	36	12		12	
9	Bo	10	10	13	33	11			
10	Isaiah	20	22	24	66	22			
11	Erin	15	18	18	51	17		17	52
12	Nikki	22	18	20	60	20	70		
13	Charly	10	13	16	39	13		13	
14	Gabby	16	16	16	48	16			
15	Oliver	10	11	12	33	11			
16	Simone	24	20	22	66	22			
17	Jesse	11	9	10	30	10			
18	Antonio	14	15	16	45	15		15	

Evaluation Rubric

Component	4	3	2	1
Force and motion	Explanation included: • the use of balanced forces to explain the soccer ball at rest and unbalanced forces to move the ball • the strength of the force (kick) determined the distance the ball traveled • use of data to predict what types of kicks (force) was needed to score the goal with 5 people	Explanation included: • forces were unbalanced to move the ball • the strength of the force (kick) determined the distance the ball traveled • use of data to predict what types of kicks (force) was needed to score the goal	Explanation included: • forces moved the ball • strength of kick determine how far it went	Explanation included: • the kick was a push that moved the ball • a hard kick moved the ball better
Analyze and interpret data	• used data from tables and graphs to select a team capable of scoring at 80 yards • explained the selection of teams based on the strength of their force (kicks) to make the goal in 5 touches	• used data from tables or graphs to select a team capable of scoring at 80 yards • explained the selection of teams based on the strength of their force (kicks) to make the goal	• indicated data but did not use reasoning to make an explanation	• did not use data in their explanation
Cause and effect	A statement which included: • how the strength of the force affected the distance that the ball traveled • the selection of team distances affected whether or not the ball traveled 80 yards and how it relates to the game.	A statement which included: • how the strength of the force affected the distance that the ball traveled • a mention of cause and effect and how it relates to the game.	A statement which included: • a mention of cause and effect but not related to their game.	Their statement did not relate to patterns or cause and effect.

Next Generation Science Standards (NGSS)

This lesson is building toward:

PERFORMANCE EXPECTATIONS (PE)	
3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*]

NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

SCIENCE AND ENGINEERING PRACTICES (SEP)

Analyzing and Interpreting Data

- Represent data in tables and/or various graphical displays (ex: bar graphs) to reveal patterns that indicate relationships.
- Analyze and interpret data to make sense of phenomena using logical reasoning, mathematics, and /or computation.
- Analyze data to refine a problem statement or the design of a proposed object, tool, or process.

DISCIPLINARY CORE IDEAS (DCI)

PS2.A: Forces and Motion

- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's distance speed or direction of motion.
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it.

CROSSCUTTING CONCEPTS (CCC)

Patterns

- Patterns of change can be used to make predictions.

Cause and Effect

- Causes and effect relationships are routinely identified, tested, and used to explain change.

Appendix 3.3

Common Core State Standards (CCSS)

CCSS ELA SPEAKING AND LISTENING
CCSS.ELA-LITERACY. SL.3.1 Engage effectively in a range of collaborative discussions ~~(one-on-one, in groups, and teacher-led)~~ with diverse partners on *grade 3 topics and texts*, building on others' ideas and expressing their own clearly.
CCSS MATHEMATICS MEASUREMENT AND DATA
3.MD.B.4: Represent and interpret data. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. ~~Show the data by making a line plot, where the horizontal scale is marked o" in appropriate units—whole numbers, halves, or quarters.~~
3.MD.B.3: Represent and interpret data. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. ~~Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.~~

California English Language Development (ELD) Standards

CA ELD		
Part 1.3.1 Exchanging information and ideas.		
EMERGING	**EXPANDING**	**BRIDGING**
Contribute to conversations and express ideas by asking and answering *yes-no* and *wh-* questions and responding using short phrases.	Contribute to class, group, and partner discussions, including sustained dialogue, by following turn-taking rules, asking relevant questions, affirming others, and adding relevant information.	Contribute to class, group, and partner discussions, including sustained dialogue, by following turn-taking rules, asking relevant questions, affirming others, adding relevant information, building on responses, and providing useful feedback.
In addition to the standard above, you may find that you also touch on the following standard in this lesson as well: **P1.3.9** Plan and deliver brief oral presentations on a variety of topics and content areas.		