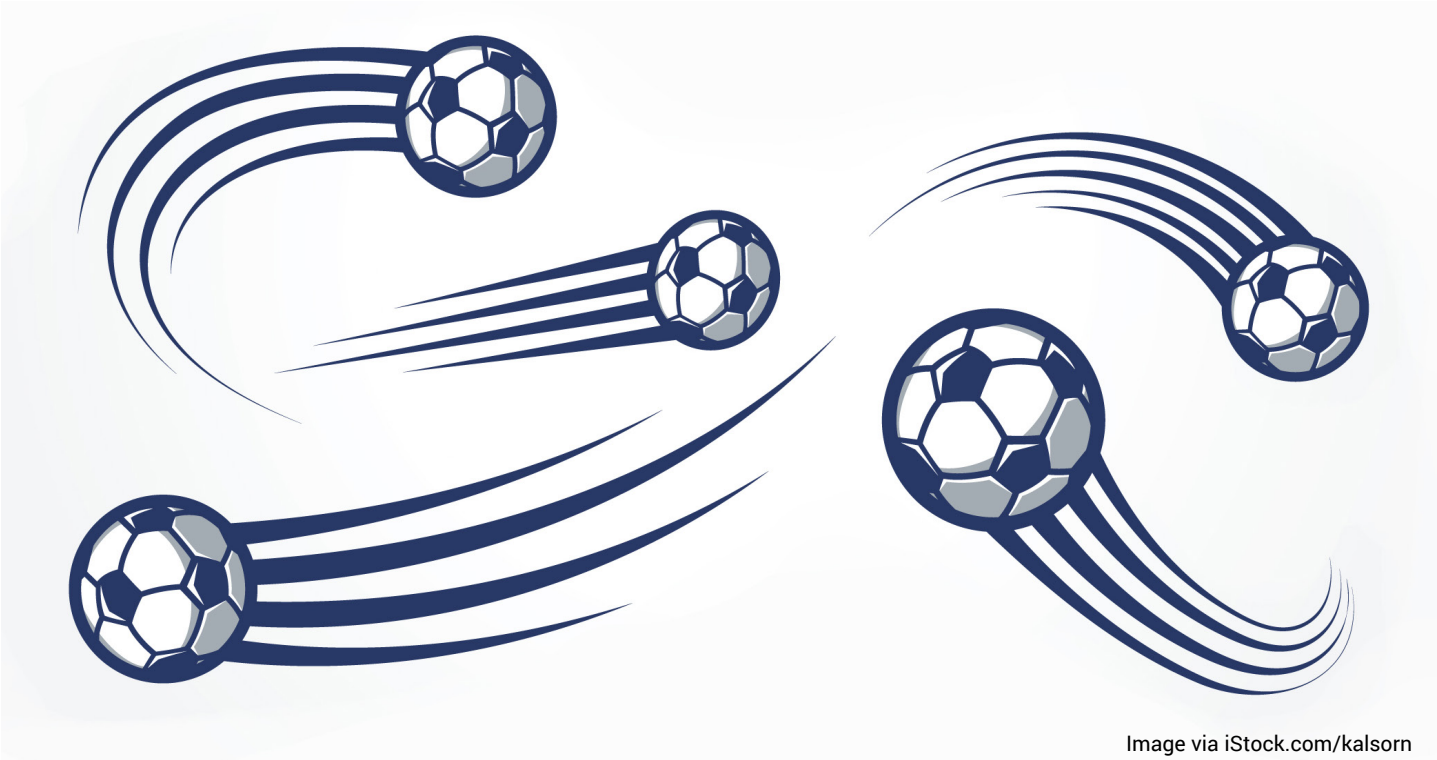
Huff, Puff, and Move the Ball

K.4



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Anchoring Phenomenon

Objects do not move on their own.

Lesson Concept

Plan and carry out an investigation to determine the cause and effect (strength and direction) of a push on an object.

Investigative Phenomenon

Windy days change how the ball moves in soccer.

Standards

Refer to Appendix K.4 for NGSS, CCSS (ELA and Math), and California ELD Standards.

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

Driving Question

How does wind push a soccer ball?

Storyline Link

In Lesson 3: Cruising Discs, the force of the push was explored through the game of mini-shuffleboard. Different strengths of the force caused the disc to move lesser or greater distances in the game of mini-shuffleboard.

In this lesson, the students' understanding of the strength of pushes is deepened by changing the cause of the push. (CCC) This lesson explores the phenomenon of pushes on a ball from high winds. (CCC)

While we cannot see wind, we can see what wind does to objects. We can investigate the phenomenon that windy days change the way a ball moves. The phenomenon of wind moving things can be investigated by blowing through two different-sized straws, causing a small ball or pom-pom to move at different speeds. (DCI) Collecting and analyzing data from blowing through two different-sized straws deepens students' understanding of ways to change the strength of a push that, while invisible, can be felt by blowing through a straw. (SEP) When playing soccer, strong winds can push the ball in a different direction.

The second part of this lesson brings in the science and engineering practice of collaboratively designing and planning an investigation to determine how to change the direction that an object moves as well as how to change the strength of the push. (SEP)

This leads to Lesson 5: When Two Objects Collide. It explores how to use other players to get around a blocker. Investigations are used to figure out what happens when moving objects collide. Colliding objects change direction. (DCI)

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

Time

80 minutes

Part I 35 minutes

10 minutes	Engage
15 minutes	Explore 1
10 minutes	Explain 1

Part II 45 minutes

30 minutes	Explore II
10 minutes	Explain II
5 minutes	Elaborate/Evaluate

Materials

Whole Class

- ❑ Wind-Assisted Goal video (https://www.youtube.com/watch?v=BzutX8bm5mo)
- ❑ Fan with at least two different speed settings
- ❑ Soccer ball
- ❑ Bags with a set of materials for the wind investigation
- ❑ K.4.C1: Class Notebook (continuation of K.1.C1: Class Notebook started in Lesson 1: Exploration Box)

Group (Groups of 2)

- ❑ Grooved ruler (one per group)
- ❑ Rubber bouncy ball (½ inch in diameter), ping pong ball, or pom-pom (Find a ball that will stay on the ruler.)
- ❑ 8½" by 11" piece of paper
- ❑ Different-colored markers
- ❑ Gallon-sized bag
- ❑ 12" by 18" construction paper for recording the movement of the ball

Individual

- ❑ 2 Coffee straws (small diameter)
- ❑ 2 Drinking straws (large diameter)

Teacher

- ❑ K.4.R1: Wind Investigation Set-up

Advance Preparation

1. Place two coffee straws, two drinking straws, one rubber ball or ping pong ball, two different-colored markers, and one piece of 8 ½" by 11" paper in a gallon-sized bag for each set of partners.
2. Make and display a set-up of the wind investigation. (See **K.4.R1: Wind Investigation Set-up**)
3. Review the Wind-Assisted Goal video. (https://www.youtube.com/watch?v=BzutX8bm5mo)
4. Prepare the **K.4.C1: Class Notebook** as described in the Toolbox for this lesson.

Procedure

Part I

Engage (10 minutes)

Ask questions about how a soccer ball can move without a person pushing the ball.

1. Ask students to think about a day when the weather was very windy (or have students stand in front of a fan). Students consider when they have been out on a windy day and describe how they felt and what they observed. Share ideas.
2. Show the Wind-Assisted Goal video and ask students to observe the movement of the soccer ball on a windy day. Share observations. Show the video one more time, and record observations on the left side of a page of the **K.4.C1: Class Notebook** with the heading "What Do We Notice?"
3. Ask, "What do we wonder about what is happening in the video?" Students can use the sentence frame: I wonder _____.

   Record their wonderings as questions on the right side of the same page of the **K.4.C1: Class Notebook.**

> **TEACHER NOTE**
>
> Kindergarteners may wonder if something or someone is flying above the field and hit the ball. Guide students toward another explanation for what is pushing the ball. If students do not suggest the wind, introduce that concept with the fan in the next step.

4. Display a fan and ask students, "How can we use this fan to test how windy weather might affect the soccer balls?" Record ideas in the **K.4.C1: Class Notebook**. Record ideas to test.
5. Test a few of the students' ideas such as moving the direction of the fan or changing the speed of the fan by placing a ball in front of the fan so students can observe what happens to the ball. Record the results of these informal trials and any new student questions on the **K.4.C1: Class Notebook**.

> **TEACHER NOTE**
>
> Using air in this part of the sequence provides students with a better opportunity to control the strength of the push. Students are more readily able to recognize when the puff push is greater versus lesser than when they use their own fingers or hands. The use of air as a force potentially moves students beyond grade-level in the DCI as they don't yet know that air is made of particles.

Explore I (15 minutes)

Conduct an investigation to observe how the size of straws affect the distance an object travels.

6. Ask students to remember how the strong wind blew the soccer ball backward in the video. Explain that we don't have enough fans for everyone in the room. Ask, "How might we use two different-sized straws to figure out which straw would make a stronger wind that pushes the ball farther?" (Hold up the two different-sized straws). Chart ideas in the **K.4.C1: Class Notebook.**
7. Distribute the bags of materials to partners (4 straws, a ball, 2 different-colored markers, and a sheet of construction paper) and ask students to figure out which straw makes the stronger wind. Use your ideas from the **K.4.C1: Class Notebook.**
8. Debrief at the meeting place and ask students to report what they found out. Record the results on the **K.4.C1: Class Notebook**. Review the list and notice any patterns made by the wind from the large straw or the small straw. Students will report that the ball curved rather than going in a straight line.
9. Hold up a ruler with a groove down the center and tell students to go back to their work tables and figure out at least one way to use the ruler to guide the direction of the ball. Distribute a ruler to each group. Encourage practice with the ruler as a track for the object.
10. Ask students how they can figure out how to blow the same amount of air through each straw. As you walk around, listen for ideas from the students and record those ideas on the **K.4.C1: Class Notebook.**
    a. Encourage practice blowing for 3 seconds. This can be accomplished by counting aloud.
    b. Ask students to practice using the large straw and then the small straw to blow for 3 seconds. Encourage multiple practices making sure each puff is about the same strength.
11. Ask the students to remove the two different-colored markers from the bag and set up their track on construction paper. Think of a way to make marks to record how far the ball travels after each puff. Listen to several groups and record their ideas on the **K.4.C1: Class Notebook** to guide other groups.

Image via Emerson/Bandini Elementary, San Diego Unified School District [Used with Permission]

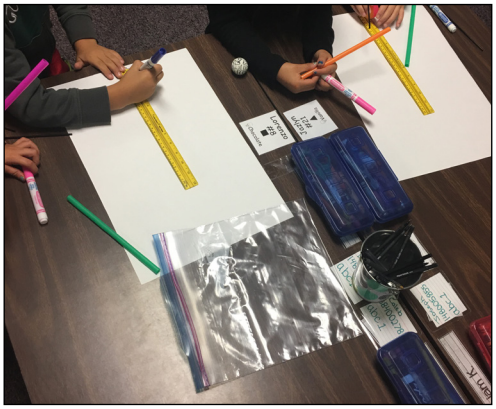


Image via Vista Unified School District [Used with Permission]

12. Ask students to set up their track with the construction paper under the ruler on their work tables. If the ball is going off the end of the ruler, they should try to blow for 2-seconds and 1-second. Have them use a different-colored marker for the different-sized straws. Remind students they can record more than one puff for each straw to see if each puff is about the same.
13. Have the students put their materials back into the bag (their straws, the ball, the ruler, and markers) and put the baggie in their cubbies to use tomorrow. Have them bring the construction paper with their recorded results to the meeting place.

TEACHER NOTE

This is an ideal opportunity to introduce or reintroduce the word *pattern*. Remind them that when we notice when something happens over and over, it may be a pattern. For example, the wider straw allows more air to hit the ball, moving it a greater distance than the thinner straw.

Students may keep their own straws in a different place such as their desk so they can use them for the next part of the lesson. Otherwise, replace their straws so that they avoid sharing germs.

Explain I (10 minutes)

Analyze and interpret data and look for patterns in the distance the ball traveled using two different-sized straws.

14. Ask partners to share individual recording sheets and talk knee-to-knee about what they noticed in the distances the ball moved from the puffs from each straw. Ask each partner to tell their partner what they noticed.
15. Ask two or three partners to come to the front and place their recording sheets in front of the class. Ask them to trace a line from where they puffed to the landing places for the ball.
    a. Compare the student samples and ask the class what patterns they notice between the recording sheets.
    b. Ask, “What caused the ball to move farther with the large straw? What caused the ball to stop sooner with the small straw?”
    c. Ask, “What is the pattern between discs in the last lesson and how the ball moved in this lesson?” Record patterns on a page of the **K.4.C1: Class Notebook**, “Things We Figured Out About Pushes.”

TEACHER NOTE

The guiding questions are designed to get the students to make the connection that a greater push of air causes the ball to travel a greater distance. A smaller push of air, or lesser push of air, causes the ball to travel a shorter distance. Students may notice that not all recorded distances are exactly the same. Lead a discussion of how the puffs might be different for different students.

Part II

Explore II (30 minutes)

Plan and conduct an investigation to test the effects of air puffs to change the direction of the ball's movement.

16. Display the **K.4.C1: Class Notebook** (Things We Figured Out About Pushes) and review what causes things to move farther. Share any patterns.

17. Review several pages of the **Class Notebook** to identify what we have figured out about what makes a ball move, how we increase the speed at which an object moves by pushing a disc, or by blowing in a straw, and how we stop a ball. Today we want to see if we can use the same materials and plan a way to make the ball go in a different direction.

18. Display one of the sets of the material used yesterday—the ball, the ruler, and the two straws. Tell students one player will push (kick) the ball with their fingers, and the other player will use a straw to be the wind blowing to try to change the ball's direction (as we saw in the video). Ask partners to talk about how we can plan to make the ball go in different directions using the wind.

19. Display a new page in the **K.4.C1: Class Notebook** (Our Plan to Change Directions.) Ask students for ideas of how to change the direction the ball moves (using the straw) after the kick (the tap with the fingers). Also, discuss how they will record the path of their ball. Record all ideas on the top half of the **K.4.C1: Class Notebook**.

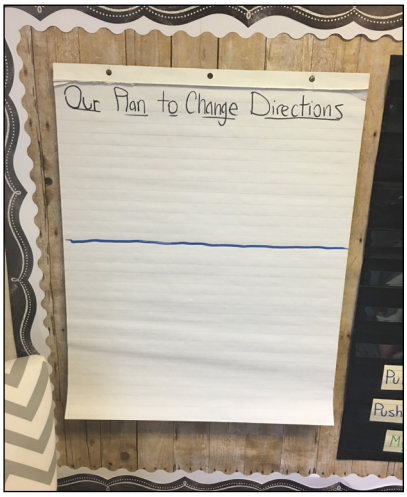


Image via Vista Unified School District
[Used with Permission]

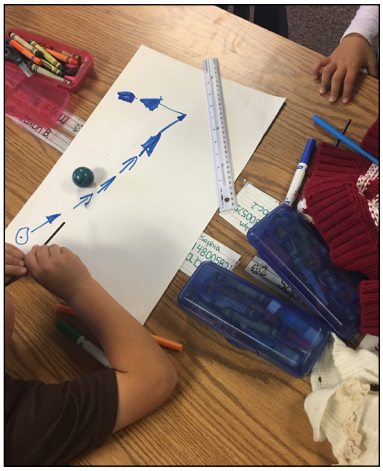
20. Guide students to select which of the ideas might work for the whole class to try. First, ask students to identify ideas that might work. Then establish an order in which to try the ideas. Record the ideas in order on the bottom of the page.

21. Write "#1 Idea" on the **K.4.C1: Class Notebook** page and use pictures and or words to plan each step of the idea including recording the path of the ball. Remember one person is the kicker (using a tap) and one person is the wind (using a straw).

22. Ask students to use the bags of materials they put in their cubbies yesterday and a piece of construction paper. Have them set up the investigation according to the class plan.

    a. Record results directly on the construction paper. Use arrows to record the movement and direction the ball travels from the kick (tap) through the movement caused by the air puff (blowing through the straw).

    b. Repeat by conducting the investigation three times. Use a different- colored marker to record each trial on the construction paper.



This class did the investigation differently. They blew with the straw and changed the direction with the ruler.

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Explain II (10 minutes)

Analyze and interpret data to determine the effects of the air puffs on the movement of the ball.

23. Have students return to the meeting place, bringing the construction paper. Share different recording sheets and ask each set of partners how they were able to change the direction of the ball. Ask the whole group, "What patterns do we see in the recording sheets?"

24. Review the other plans selected in the **K.4.C1: Class Notebook** page and discuss whether students need to do additional plans. If yes, additional plans can be explored during free-choice time and reported tomorrow.

25. Read *The Three Little Pigs* and talk about how the huff and puffs forced the homes to move or not move. Why do students think the brick house did not blow over? Discuss the differences between fiction and nonfiction.

Elaborate/Evaluate (5 minutes)

Construct an explanation about what caused the soccer ball to change direction in the video.

26. Play the Wind-Assisted Goal video, and ask students to think about how the video is like the plan for changing the direction of the ball using the straw and wind. Ask the group, "What is the same about the wind blowing the soccer ball and the puff of air blowing the balls in our plan? What is different?"

27. ▶ Review the "figuring out pages" created in the Class Notebook during the last four lessons. Which pages show what we have figured out? Go through the pages and check to see if the class has a clear understanding of
    a. ways to make the ball move,
    b. ways to push or pull soccer materials to the field,
    c. ways to strengthen the distance of the movement of the ball,
    d. ways to stop the movement of the ball by pushing in the opposite direction,
    e. ways to direct the movement of the ball.

    Develop a new page in the **K.4.C1: Class Notebook** with the heading: "What We Know for Sure About Pushes and Pulls in Soccer."

> **TEACHER NOTE**
>
> Leave the materials out for practicing pushes and pulls with the wind and rulers at the choice centers until students all seem confident with predicting the pattern of the path of the ball or pom-pom using the ruler and blowing using their own personal straws saved in their cubbies.

28. Display the **Class Notebook** page of additional questions brainstormed at the end of Lesson 3: Cruising Discs. Focus on any questions about getting around a blocker or another player. Tomorrow we will work on figuring out how to get around other players to answer that question.

Literacy Links

Have students interact with text to extend their understanding of pushes. These selections can be read aloud at any time after this lesson. Suggested books include the following:

Fiction:

- *Duck in the Truck* by Jez Alborough
- *Sheep in a Jeep: 5-Minute Stories* by Nancie Shaw and Margot Apple
- *Playground Day!* by Jennifer J. Merz

References

Alborough, J. (2014). *Duck in the Truck*. Tulsa, OK: Kane Miller.

Euronews. (2015, November 20). Crazy wind-assisted own goal! Retrieved from https://www.youtube.com/watch?v=BzutX8bm5mo

Merz, J. J. (2007). *Playground Day!* New York, NY: Clarion Books.

Shaw, N., & Apple, M. (2019). Sheep in a Jeep 5-minute stories. Boston, MA: Houghton Mifflin Harcourt.

Toolbox Table of Contents

Class Notebook (continued from Lesson 1)

What do we notice?

I wonder _____.

How can we use this fan to test how windy weather might affect the soccer balls?

Results

How might we use two different-sized straws to figure out which straw pushes the ball farther?

What happened when we blow into the straw:

With different amounts of air?

With the same amount of air?

Class Notebook (continued)

Patterns made by the wind with the large straw and small straw.

How can we mark the distance the ball travels on the ruler?

Things We Figured Out About Pushes

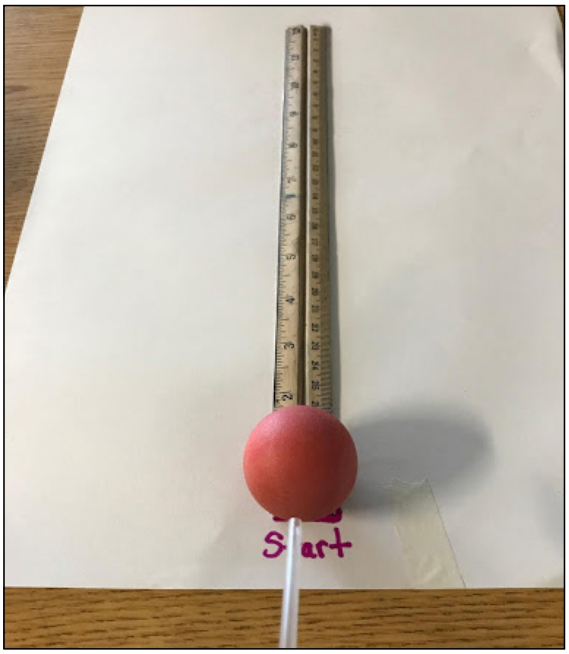
Our Plan to Change Directions

#1 Idea

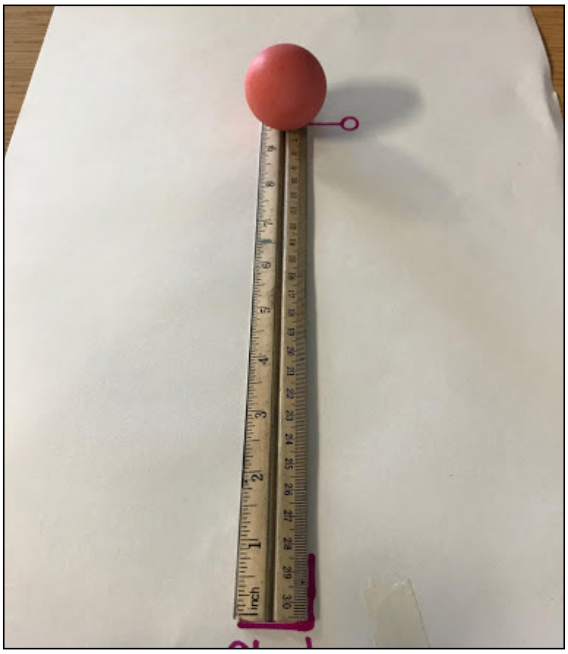
Class Notebook (continued)

What we know for sure about pushes and pulls in soccer?

Wind Investigation Set-up



Set-up position for the straw and the ruler.



Mark the finish position of the ball on the ruler.

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Appendix K.4

Huff, Puff, and Move the Ball

Next Generation Science Standards (NGSS)

This lesson is building toward:

PERFORMANCE EXPECTATIONS (PE)	
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. [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [*Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*]
K-PS2-2	Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [*Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.*]
K-ESS2-1	Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of the qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm): examples of quantitative observations could include number of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: (Assessment of quantitative observations is limited to whole numbers and relative measures such as warmer/colder.)*]

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

SCIENCE AND ENGINEERING PRACTICES (SEP)
Planning and Carrying Out an Investigation
• With guidance, plan and conduct an investigation in collaboration with peers.
Analyzing and Interpreting Data
• Use and share pictures, drawings, and/or writings of observations.
Asking Questions and Defining Problems
• Ask questions based on observations to find more information about the natural and / or designed world(s).
Obtaining, Evaluating, and Communicating Information
• Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. • Obtain information using various texts, text features (e.g., heading, tables of contents, glossaries, electronic menus, icons) and other media that will be useful in answering a scientific question and/or supporting a scientific claim.

Appendix K.4

DISCIPLINARY CORE IDEAS (DCI)
PS2.A Forces and Motion
• Pushes and pulls can have different strengths and directions.
PS3.C: Relationship Between Energy and Forces
• A bigger push or pull makes things speed up or slow down more quickly.
ESS2.D Weather and Climate
• Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.

CROSSCUTTING CONCEPTS (CCC)
Cause and Effect
• Simple tests can be designed to gather evidence to support or refute student ideas about causes.
Patterns
• Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Common Core State Standards (CCSS)

CCSS ELA READING
CCSS.ELA-LITERACY.R1.K.1
With prompting and support, ask and answer questions about key details in a text.
ELA SPEAKING AND LISTENING
CCSS.ELA-LITERACY.SL.K.3
Ask and answer questions in order to seek help, get information, or clarify something that is not understood
MATH PRACTICES
CCSS MP2
Reason abstractly and quantitatively.
MATH MEASUREMENT AND DATA
CCSS.Math.K.MD.A.1
Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
CCSS.Math.K.MD.A.2
Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference.

Appendix K.4

California English Language Development (ELD) Standards

CA ELD		
Part I.K.12a,b Selecting and applying varied and precise vocabulary and other language resources		
EMERGING	**EXPANDING**	**BRIDGING**
a) Retell texts and recount experiences using a select set of keywords. b) Use a select number of general academic and domain-specific words to add detail (e.g., adding the word *spicy* to describe a favorite food, using the word *larva* when explaining insect metamorphosis) while speaking and composing.	a) Retell texts and recount experiences using complete sentences and keywords. b) Use a growing number of general academic and domain-specific words in order to add detail or to create shades of meaning (e.g., using the word *scurry* versus *run*) while speaking and composing.	a) Retell texts and recount experiences using increasingly detailed complete sentences and keywords. b) Use a wide variety of general academic and domain-specific words, synonyms, antonyms, and non-literal language to create an effect (e.g., using the word *suddenly* to signal a change) or to create shades of meaning (e.g., The cat's fur was *as white as snow*.) while speaking and composing.
In addition to the standard above, you may find that you touch on the following standards in this lesson as well: **P1.K.1** Exchanging information and ideas via oral communication and conversations **P1.K.2** Interacting with written English (print and multimedia) **P1.K.5** Listening actively and asking or answering questions about what was heard		