Dear Kindergarten Parents/Guardians,

The unit of study in Amplify Science that we are working on is called Pushes and Pulls.

In this unit, students take on the role of pinball engineers to explore how pinball machines allow people to control the direction and strength of forces on a ball, which serves as the anchor phenomenon of the unit. They conduct tests on their own prototypes of a pinball machine (called Box Models) and use what they learn to solve the design problem of creating a Class Pinball Machine. Regular circle-time discussions facilitate students' growing understanding of ideas related to force and motion, as well as their ability to use language to describe these fundamental ideas. In the process, students learn about how engineers design and test solutions to problems. Students each contribute evidence from the tests they conduct using their Box Models to help make decisions about how to design the Class Pinball Machine, something that can remain in the classroom even after the unit is complete. At the end of the unit, students use their new understanding of the phenomena of force and motion to identify pushes and pulls more broadly in their lives.

In Chapter 1, students view a video of a homemade pinball machine in action, and then are challenged to design a Class Pinball Machine that can do all the things they want it to do. The class learns about forces and engages in the design cycle to create a solution related to the Chapter 1 Question: How do we make a pinball start to move? Students investigate starting movement by exploring a variety of familiar and new materials and by visualizing, which enables students to come to the conclusion that forces happen between objects. Students also read about how forces are exerted in the book Talking about Forces and learn about cause-and-effect relationships, which help them explain that objects begin to move when another object exerts a force on them. Students engage in their role of pinball engineers by first creating a Box Model—which allows them to try out their ideas—and then by drawing a diagram. By the end of the chapter, students learn that engineers design solutions to try to make something new that people want or need. The purpose of this chapter is for students to gain experience with the design cycle, including finding out about problems and designing solutions; to understand that forces happen between two objects; and to recognize that an object starts to move when another object exerts a force on it.

In Chapter 2, students tackle the Chapter 2 Question: How do we make a pinball move as far as we want? They construct an understanding of the forces needed to move a pinball long and short distances, which helps them meet two new design goals for the Class Pinball Machine. After watching how the pinball machine in the Pinball video launches the ball different distances, students engage in firsthand and secondhand investigations in order to figure out the relationship between the strength of a force exerted (gentle or strong) and the distance an object moves (short or long). Students design a launcher for their Box Models that will allow them to exert the right amount of force on their pinballs. By the end of the chapter, the class adds a new launcher to the Class Pinball Machine and discusses how certain forces cause the ball to move different distances. The purpose of this chapter is for students to learn that objects move short and long distances depending on the strength of the force exerted on them, to gain fluency with the language they need to explain this phenomenon, and to understand that an important part of engineers' work involves modifying their solutions to problems as they learn more.

In Chapter 3, students work together to figure out the answer to the question How do we make a pinball move to a certain place? They observe, through hands-on exploration and reading Building with Forces, what kinds of forces move objects to the left and the right. By combining the ideas about directionality with the ideas about gentle and strong forces from Chapter 2, students figure out what forces need to be

exerted to roll a ball so it can move to a target. They add a target to their Box Model and try to apply the right kind of force to the pinball in order to hit that target. Finally, students draw diagrams of their work before discussing and sharing their learning through a Shared Writing activity, noting how sharing ideas is part of engaging in the work of engineers. By the end of the chapter, students apply what they have learned about strength and direction of forces to hit a target in the Class Pinball Machine. The purpose of this chapter is to expand students' experiences with the design cycle and for students to learn that every force has a strength and a direction which affects the distance and direction an object moves.

In Chapter 4, students work to answer the question How do we make a moving pinball change direction? Students notice how the moving pinball in the video changes direction by hitting flippers and bumpers. They gather evidence to understand what forces might cause an object to change directions—first by observing how to make a tennis ball and a foam ball change direction, then by visualizing objects changing direction as they read the book Forces in Ball Games, and finally by trying out their ideas in their Box Models. These experiences help students understand that a force from either a moving or still object can cause a moving object to change direction. By the end of the chapter, students add two flippers and a bumper to the Class Pinball Machine, and then explain and write about how forces cause a moving object to change direction. They also meet another design goal: Make the ball change direction in different ways. The purpose of this chapter is for students to learn that a moving object can change direction when either a moving or a still object exerts a force on it.

In Chapter 5, students redesign their Box Models to make sure the models can do all the things they want them to do. They read the book Room 4 Solves a Problem, which is about how a fictional class engages in various parts of the design cycle, and are introduced to the design cycle phases of Learn, Plan, Make, and Test. Students then engage in the iterative design process themselves by making changes to their Box Models. Students write a mini-book to accompany their Box Models; in the mini-book, they explain how to use forces to play pinball in the Box Model. By the end of the chapter, students take home their completed Box Model and mini-book, finalize what they designed in the Class Pinball Machine, and check off all the unit's design goals. The purpose of this chapter is to reflect on and engage in the work of engineers, to apply students' understanding of how different forces move their pinballs in the Box Models, and to use the full design cycle to make purposeful improvements to the Class Pinball Machine.

In Chapter 6, students apply their understanding of forces to search for forces all around them. Students figure out that, while they cannot see forces, they can look for evidence of forces—when an object starts to move, stops moving, or changes direction. They gather evidence through reading and touring through the school looking for forces. The chapter and unit culminate with students reflecting on the different kinds of forces that they learned about with various objects and in the pinball machine.

Important vocabulary for each chapter can be found in the glossary on the back of this letter. Students should be able to understand and apply the key vocabulary words during class discussions and investigations, as well as in their written explanations. The concepts and vocabulary for each chapter are cumulative and build upon the understandings from the previous chapters.

Sincerely,

The Kindergarten Teachers

Unit 2: Pushes and Pulls

Chapter 1

design: to try to make something new that people want or need

engineer: a person who makes something in order to solve a problem

exert: to cause a force to act on an object

force: a push or a pull

object: a thing that can be seen or touched

solution: something that helps people do what they want or need to do

visualize: to make a picture in your mind

Chapter 2

distance: how far it is between two things

Chapter 3

direction: the way something is facing or moving, such as left, right, toward you,

or away from **you**

Chapter 4

*No new vocabulary words are presented in this chapter.

Chapter 5

*No new vocabulary words are presented in this chapter.