

## Dare to Tinker



### Logistics

These activities are designed for use in grade levels kindergarten through second grade. These activities can be completed in a regular classroom setting, provided there are opportunities to reconfigure seating arrangements to use cooperative grouping strategies.

### Materials

#### Activity 1: All Grade Levels: Storytelling (Estimated time: 30 – 45 minutes)

*For the teacher:*

- Copy of *The Most Magnificent Thing*
- Document Camera (optional)

#### Kindergarten Activity (Estimated time: 3, 30-45 minute sessions)

*For each partner team:*

- Assortment of *Brickyard Building Blocks*\* or similar item
- 1 Animal Figure\*\*
- Materials to construct a ramp at student desks (i.e., thin textbook, pencil box, ruler, etc.)
- 1 Food Basket or similar item to contain *Brickyard Building Blocks*
- Optional - Additional materials to make container for pet (i.e., small cup, box, etc.)

*For the teacher:*

- Copy of *The Most Magnificent Thing*
- 2 Testing Ramps\*\*\*
- 1 Paper Roll
- Masking Tape
- Document Camera (optional)

#### First Grade Activity (Estimated time: 3 45-60 minute sessions)

*For each partner team:*

- Assortment of *Brickyard Building Blocks*\* or similar item
- 1 Dog Animal Figure\*\*
- Materials to construct a ramp at student desks (i.e., thin textbook, pencil box, ruler, etc.)
- 1 Food Basket or similar item to contain *Brickyard Building Blocks*
- Additional Materials for Vehicle Building (see activity chart)
- 1 Small Post-it Note

*For the teacher:*

- Copy of *The Most Magnificent Thing*
- 2 Testing Ramps\*\*\*
- 1 Paper Roll
- Masking Tape
- Document Camera (optional)

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### Second Grade Activity (Estimated time: 5, 60-minute sessions)

#### *For each partner team:*

- 1 Animal Figure\*
- Ruler
- Scissors
- 2 Small plastic baggies (to collect money for vehicle cost and materials)

#### *For the class:*

- Assorted Materials for Vehicle Building (see activity chart)
- Assorted Paper/Plastic money (dimes, quarters, and dollar bills)
- 2 Testing Ramps\*\*\*
- 1 Paper Roll
- Post-it standard note sheets (1 pad of 100)

#### *For the teacher:*

- Copy of *The Most Magnificent Thing*
- Document Camera (optional)

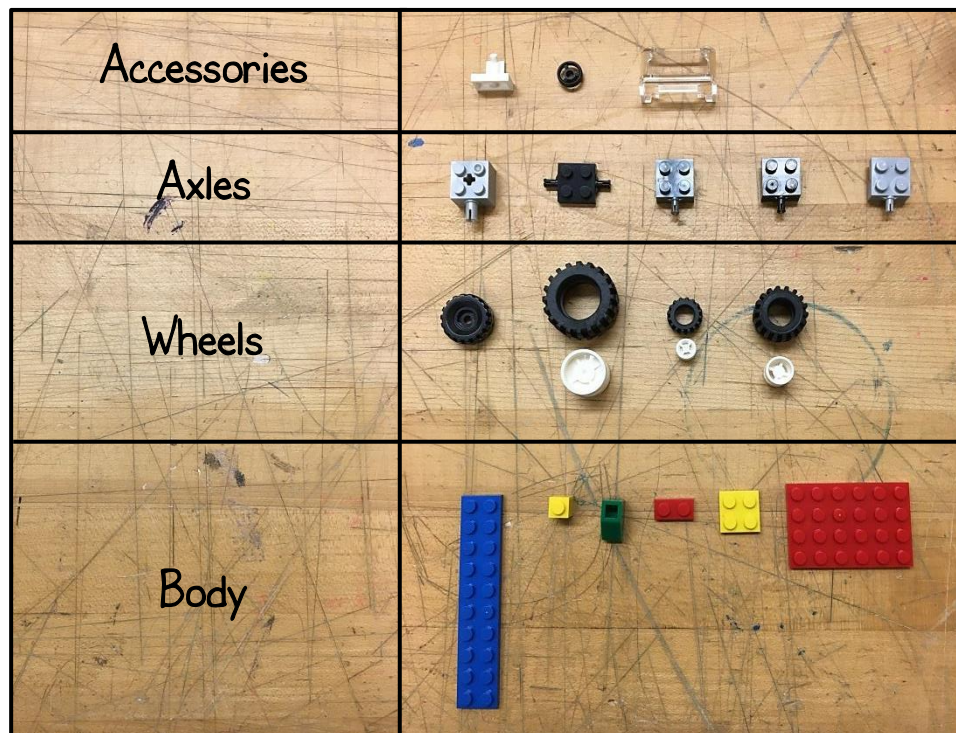


### \*Brickyard Building Blocks

**Note:** Teacher resources may be downloaded for this activity at:

[goo.gl/5yX5Yd](http://goo.gl/5yX5Yd)

The *Brickyard Building Blocks* included in this activity contains 459 pieces and allows for the construction of approximately 18 cars. Similar to LEGO® Bricks, these plastic pieces snap together. *Brickyard Building Blocks* can be purchased from multiple vendors, including Amazon and [www.brickyardbuildingblocks.com](http://www.brickyardbuildingblocks.com). The following items are included in the 459-piece kit:





### \*\*Animal Figures

The animal figures included in this activity were purchased from EAI Education as part of the Wacky n' Wild, Farm and Underwater Sea Creatures Animal Collections. The Pet Counters can be purchased from Didax. These animal figures were also used in the activity titled, "STEM Storytelling: Who Lives Here?"



### \*\*\*Testing Ramps (foam board, 9" width x 30" length with ½" sides)

Create foam board ramps by cutting 20" x 30" pieces of foam board in half lengthwise (two 10" x 30" pieces). Next, score lengthwise ½-inch down each edge of the board, fold upward, and tape to make sides, which help contain the student vehicles as they travel down the ramp.

## Standards

### NGSS Scientific and Engineering Practices:

- Asking questions and defining problems (SEP1)
- Developing and using models (SEP2)
- Planning and carrying out investigations (SEP3)
- Analyzing and interpreting data (SEP4)
- Using mathematics and computational thinking (SEP5)
- Constructing explanations and designing solutions (SEP6)
- Obtaining, evaluating, and communicating information (SEP8)

### NGSS:

- *K-2-ETS1-1*: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- *K-2-ETS1-3*: Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
- *K-2-ETS1.A*: A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.
- *K-2.ETS1.B*: Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.
- *K-2.ETS1.C*: Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
- *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.

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- *K-PS2.A*: Pushes and pulls can have different strengths and directions; pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.

### Common Core State Standards Mathematical Practices:

- *MP1*: Make sense of problems and persevere in solving them.
- *MP2*: Reason abstractly and quantitatively.
- *MP4*: Model with mathematics.
- *MP5*: Use appropriate tools strategically.

### CCSS Mathematics:

- *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.
- *1.MD.A.1*: Order three objects by length; compare the lengths of two objects indirectly by using a third object.
- *1.MD.A.2*: Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps.
- *2.MD.A.1*: Measure the length of an object by selecting and using appropriate tools such as rules, yardsticks, meter sticks, and measuring tapes.
- *2.MD.A.2*: Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen.
- *2.MD.A.3*: Estimate lengths using units of inches, feet, centimeters, and meters.
- *2.MD.C.8*: Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using \$ and ¢ symbols appropriately.

### CCSS ELA/Literacy:

- *RL.K.1*: With prompting and support, ask and answer questions about key details in a text.
- *RL.K.4*: Ask and answer questions about unknown words in a text.
- *RL.1.1*: Ask and answer questions about key details in a text.
- *RL.1.4*: Identify words and phrases in stories or poems that suggest feelings or appeal to the senses.
- *RL.2.1*: Ask and answer questions as *who*, *what*, *where*, *when*, *why* and *how* to demonstrate understanding of key details in a text.
- *RL.2.3*: Describe how characters in a story respond to major events and challenges.
- *RI.K.1*: With prompting and support, ask and answer questions about key details in a text.

- *RI.K.4:* With prompting and support, ask and answer questions about unknown words in a text.
- *RI.K.7:* With prompting and support, describe the relationship between illustrations and the text in which they appear.
- *RI.1.1:* Ask and answer questions about key details in a text.
- *RI.1.4:* Ask and answer questions to help determine or clarify the meaning of words and phrases in a text.
- *RI.2.4:* Determine the meaning of words and phrases in a text relevant to *grade 2 topics or subject area*.
- *SL.K.1:* Participate in collaborative conversations with diverse partners about *kindergarten topics and texts* with peers and adults in small and larger groups.
- *SL.K.2:* Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.
- *SL.K.3:* Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- *SL.K.6:* Speak audibly and express thoughts, feelings and ideas clearly.
- *SL.1.1:* Participate in collaborative conversations with diverse partners about *grade 1 topics and texts* with peers and adults in small and larger groups.
- *SL.2.1:* Participate in collaborative conversations with diverse partners about *grade 2 topics and texts* with peers and adults in small and larger groups.

## Introduction

Picture books that are interesting to young readers can be used to increase student motivation and engagement in science and mathematical content. Integrating multiple areas of the curriculum into a single lesson or unit enables students to see the value of the mathematics in science, or conversely, the value of science in mathematics. Literature is a vehicle that can be used to integrate the two. Both the NCTM (National Council of Teachers of Mathematics) and the NSTA (National Science Teachers Association) advocate the use of children's literature to teach important science and mathematical concepts.

Children's literature can be used to introduce a science phenomenon or mathematical concept, can be utilized as the context under which a science or mathematical/statistical investigation is based, and can be used as a resource to generate questions and build problem-solving skills. Additionally, the illustrations in picture books can promote the

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development of inferential reasoning skills as questions are posed by the teacher that ask students to look beyond what is readily observed.

### Activities

This series of activities invites students to engage in a design challenge that elicits mathematical and scientific thinking. Through the development and performance of a handcrafted “magnificent vehicle”, students will connect STEM concepts and practices with literature. Learners will actively engage in the engineering design cycle, discuss forces in motion, and evaluate their vehicle prototype using measurement and data techniques.

In the first activity, the picture book *The Most Magnificent Thing* by Ashley Spires will be used as a catalyst to discuss the engineering design process as experienced by the protagonist, a little girl. Suggested questioning techniques and inferential reasoning strategies will focus on the trials and tribulations, frustrations, and successes achieved by the little girl. Additionally, discussion prompts are included to provide students an opportunity to reflect on the little girl as a mathematician and scientist as she takes action and makes decisions throughout her design journey. This book is utilized at all grade levels to introduce the subsequent activity.

In the kindergarten activity, students will focus on constructing a vehicle to carry a pet the longest distance down a ramp. Learners will begin by exploring a set of *Brickyard Building Blocks* materials, determining how they could be utilized in building a vehicle, and then working cooperatively to construct their pet transport. After testing their vehicle and measuring the distance each prototype has traveled, students will analyze the class data while discussing which vehicles traveled the furthest, shortest, and what characteristics of a design may contribute to the vehicle’s performance.

In the first-grade activity, students will use *Brickyard Building Blocks* in addition to common materials to complete the given design challenge. Students will examine the performance of their vehicle by measuring the distance it travels using a non-standard unit, and compare their data to that of their peers.

The second-grade activity uses common materials to address an engineering design challenge: make a “magnificent” transportation vehicle for an animal passenger that can travel a minimum distance of 12 inches

past the end of the foam ramp when released at the top of the ramp. In addition, students will analyze the “cost” of building their animal transport vehicle and will collect and analyze distance data to determine which design features of the various vehicles built led to the longest travel distances.

### **Activity 1: Storytelling**

#### **Objectives:**

- Read the story *The Most Magnificent Thing* by Ashley Spires.
- Use Storytelling-Questioning techniques to develop inference skills and an understanding of the engineering design process.
- Consider what mathematics/science is and what mathematicians/scientists do.

#### **Standards:**

NGSS: K-2-ETS1-1, K-2-ETS1.A, K-2-ETS1.C, SEP8

CCSS ELA-Literacy: RL.K-2.1, RL.K-1.4, RL.2.3, RI.K-1.1, RI.K-2.4, RI.K.7, SL.K-2.1, SL.K.2, SL.K.3

#### ***Storytelling Activity*** **Materials:**

##### *For the teacher:*

- Copy of *The Most Magnificent Thing* by Ashley Spires
- Document Camera (optional)

Estimated Time: 30 - 45 Minutes

#### **Suggested Inquiry Approach:**

Students will be arranged either at their desks so that they can see the illustrations shown using a document camera, or gathered together on a carpet to listen to the story and observe the illustrations.

Before beginning the story, pose the following questions:

- **What do you think this book will be about?**
- **What characters do you think might be in this book?**

Begin reading the story *The Most Magnificent Thing*. The story begins by introducing the protagonist, a little girl, and her best friend in the whole wide world, a dog.







- *Do you think the little girl is doing science? Why or why not? Convince me.*

### **When she is finished...**

- *Did the little girl's plan work? How do you know?*
- *How do you think the little girl feels right now?*

### **When she is finished...**

- *Did the little girl fail again at making the "magnificent thing"? Explain.*
- *Why do you think she decided to try again? Would you try again?*
- *Do you think that mathematicians and scientists sometimes have to try a few times to do something right? Why or why not?*

### **The girl saws and glues...**

- *What do you think it means to adjust something?*
- *Why do you think the little girl is examining and studying her "magnificent thing"?*
- *Do you think the little girl is going to give up on making her "magnificent thing", or do you think she will keep trying her hardest? Why do you think this?*

### **Her hard work...**

- *If you were the little girl, how would you feel at this point in the story? Be specific.*

### **The angrier she gets...**

- *Looking at illustration on this page, how do you think the little girl is feeling? How do you know this?*
- *Do you think mathematicians and scientists ever have brains that are "too full of all the not-right things"? Why do you think this?*

### **The pain starts...**

- *Have you ever been so frustrated that you thought you would explode? What happened?*
- *What do you think the little girl could do to calm down?*

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### *I'm no good...*

- *Looking at the illustration on this page, how do you think the little girl is feeling? How do you know this?*
- *What do you think we could say to the little girl to encourage her to try again?*

### *There are some parts...*

- *Can you tell how many “wrong” things she made? How do you know this?*
- *What do you think, “There are some parts of the WRONG things that are really quite RIGHT” means?*
- *What do you think the little girl will do next? Why do you think this?*

### *By the time she reaches...*

- *What do you notice that people are doing while the girl finishes making the “magnificent thing”?*
- *Do you think these people are glad that the little girl failed so many times? Why do you think this?*
- *Do you still think you know what the “magnificent thing” is, or do you want to change your idea? How sure are you?*

### *The pair take a good, long look...*

- *What was the “magnificent thing” that the little girl built?*
- *Why do you think the little girl built this “magnificent thing”?*
- *Do you think the “magnificent thing” was exactly what the little girl pictured in her mind at the beginning of the story? Why or why not?*

### **Assessment/Debrief Activity 1:**

Following the completion of the story, allow adequate time for students to discuss key details of the story. During this time, encourage students to reflect on the little girl’s journey through the engineering design process. Suggested debrief questions include:

- ***Do you think it was challenging for the little girl to make the “magnificent thing”? Why or why not? How do you know this?***

- *Think about how long it took the little girl to make the “magnificent thing”. What do you think the little girl learned each time she tried to made the “magnificent thing” but failed?*
- *At the end of the story, when the little girl finally made the “magnificent thing”, how do you think she felt?*
- *During the story, I asked if you thought the little girl was doing mathematics. Think about what it means to “do” math. Do you think the little girl was a mathematician? Explain.*
- *During the story, I asked if you thought the little girl was doing science. Think about what it means to “do” science. Do you think the little girl was a scientist? Explain.*
- *Do you think mathematicians and scientists have to try things out like the little girl did? What do you think happens if they fail?*



To assess or extend student understanding, instructors may choose to have learners reflect on the little girl’s journey through the engineering design process and creation of the “magnificent thing”. The following prompts would be appropriate topics for students to address, either in written form or by illustration, in a journal:

- *Throughout the story, the little girl has many feelings. How did she feel at the beginning, middle, and end of the book?*
- *If you could make a ‘magnificent thing’ that would help fix a problem, what would it be? What would it look like? Who would use it?*
- *In the story, we talked about how the girl was being a mathematician/scientist. What does a mathematician/scientist look like? What do they do?*

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## Kindergarten Activity

### Objectives:

- Engage in the engineering design process to brainstorm solutions to a problem and then build, test and refine a working prototype (i.e., pet transport vehicle).
- Quantify the distance in which the vehicle travels using measurement and data techniques, and discuss how forces in motion affect the manner in which the vehicle travels.

### Standards:

NGSS: K-PS2-2, K-PS2.A, K-2.ETS1.C, K-2-ETS1.A, SEP1, SEP2, SEP3, SEP4, SEP8

CCSS Mathematics: K.MD.A.2, MP1, MP2, MP4, MP5

CCSS ELA/Literacy: SL.K.1, SL.K.6

Estimated Time: 90-135 minutes  
(3, 30-45 minute sessions)

### Advanced Preparation:

The following materials should be prepared prior to the start of the activity:

- Students will use a smaller ramp to explore materials at their desk. Identify several materials that could be used to form this ramp (e.g., a thin textbook propped up with a pencil box) and verify that each partner team has access to these materials.
- Separate the *Brickyard Building Blocks* into a sample materials collection for each partner team. Refer to the diagram on page 2. A small food basket or snack bag may be used to contain the collection. Each partner team should receive at least one wheel set, accessory item, body piece, and axle part.
- Determine how partner teams will receive their building blocks to construct their vehicle.
- Prepare the testing ramps, made of foam board, and place in an open and accessible area of the classroom. One end of each ramp

### **Kindergarten Activity**

#### **Materials:**

*For each partner team:*

- Assortment of *Brickyard Building Blocks* or similar item
- 1 Animal Figure
- Materials to construct a ramp at student desks
- 1 Food Basket or similar item
- Additional materials to make container for pet (optional)

*For the teacher:*

- Copy of *The Most Magnificent Thing*
- 2 Testing Ramps
- 1 Paper Roll
- Masking Tape

should be placed at a height of approximately eight inches from the floor with the other end preferably placed on a tile or wood floor (non-carpeted). However, you may adjust the height of the ramps as desired. Books, wooden blocks, or other solid materials may be used to prop up the ramps. The important point is to keep each ramp the same height off the ground. Steep ramps may interfere with the smooth transition of the vehicle from the ramp to the floor.

## Suggested Inquiry Approach:

### Day 1: Storytelling and Material Inquiry (45 minutes)

Inform students that they will be reading *The Most Magnificent Thing* and listening to a story about a little girl that tries her hardest to make the most “magnificent thing”. The storytelling-questioning strategy listed in *Activity 1: Storytelling* can be used to facilitate student discussion during the read-aloud. At the end of the picture book, take several minutes to discuss the *Activity 1* debrief questions as a class.

In the next segment of the activity, students will work with a partner to complete a hands-on mathematical and scientific investigation. You may choose to pair students based on academic level, behavior, or other indicators.

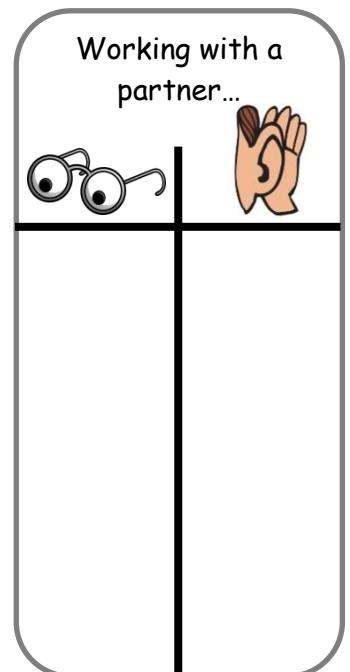
Additionally, it may be necessary to review appropriate ways to work with a partner. For example, you may ask students to complete a T-Chart to identify what working with a partner “looks like” and “sounds like” or refer to the *Working with a Buddy* card, included in this activity.

Verify that students are seated with their assigned partner. Then, turning the picture book *The Most Magnificent Thing* to the last page, show the whole class the picture of the little girl riding her scooter with her dog in the sidecar. You may wish to circulate around the room or display this image using a document camera.

Ask students the following questions:

- Why do you think the little girl wanted a “magnificent thing” for her best friend, a pet dog?
- What do you notice about the “magnificent thing” that the little girl made for her dog?
- Let’s call the “magnificent thing” a vehicle. Can you describe any other examples of a vehicle?
- What do you think makes the vehicle move?

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Next, inform students that they will work with a partner to design their own “magnificent thing”, a vehicle, to carry a pet figure the longest distance down a ramp. Verify that students understand the pet must stay in the vehicle as it moves and cannot be secured inside the vehicle with tape or any other material.

Begin the investigation by providing each partner team with a bag of sample materials. Ask students to carefully remove the sample materials from the bag and lay them out on their desk. Inform students that they will use these materials to build their vehicle, but must first explore how they could be used to construct their “magnificent thing”.

At this time, ask students to locate a specific piece of their sample materials. **Note: Do not refer to an item as an “accessory” or “wheel”, but instead, select a piece and hold it up for students to view.** Instruct learners to take turns moving the item around on their desk. Encourage them to move the items in as many ways as possible. As students are working, pose the following questions for class discussion:

- How does your \_\_\_\_\_ piece move?
- What is making your \_\_\_\_\_ piece move?

Students should investigate each sample material item, answering the previous questions for each tested object. During this conversation, students should observe that objects move differently; they slide, move fast, slow, zigzag, roll, etc. Student discussion should reflect an understanding that the objects are moving in response to a student pushing or pulling the object. Additional questions posed by the instructor may address what it means to push or pull an object, the direction in which it travels when pushed or pulled, and what other materials found in the classroom may be moved in this manner.

Next, ask students to retrieve the materials that will be used to construct a ramp. Model how to arrange the materials. Then, ask students to take turns placing each item at the top of the ramp and letting go. It is important that students do not push or pull the item, but simply place it on the ramp without any force. Students should observe how each piece moves when released from different positions and heights. Pose the following questions during the student investigation:

- How does your \_\_\_\_\_ piece move on the ramp?
- What do you think is making your \_\_\_\_\_ piece move?

Students should investigate each sample material item, answering the previous questions for each tested object.

Once all objects have been placed on the ramp, ask the whole class:

- **How do you think the \_\_\_\_\_ piece could be used to build a vehicle that will carry a pet down the ramp?**
- **When you build your vehicle with these materials, do you think there is a right way and wrong way to use them?**

### Day 2: Design Challenge (30-45 minutes)

Once students have had ample time to investigate their building materials, ask each partner team to select a pet figure that will be carried inside their vehicle. Then, direct student attention to the testing ramps and explain to students the purpose of this device.

At this time, direct partner teams to begin piecing together materials to build a vehicle that will carry a pet the longest distance down a ramp. While students are working, circulate the room to assist learners, informally assess understanding and observe the following:

- **Students working collaboratively and engaging in cooperative learning.**
- **Students using fine motor skills to join pieces of their vehicle.**
- **Students utilizing their desk ramps to test prototypes.**
- **Students experiencing engineering challenges and persevering to find solutions.**

Once it is evident that most partner teams have constructed an initial vehicle prototype, ask all groups to step away from their materials and take several minutes to talk about their progress. At this time, partner teams that are struggling may gain insight and potential design solutions from their peers. Suggested discussion questions include:

- **Tell me about how you and your partner are using the materials.**
- **Is anyone experiencing a challenge? How can we help?**
- **Whose partner had a great idea you would like to share?**
- **What is something new that you are thinking about trying?**

Encourage students to continue their work. If necessary, provide frequent updates regarding the amount of time left to work.



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### Day 3: Final Testing and Measurement (45 minutes)

Ask all partner teams to bring their vehicle to the testing ramps. Before testing the vehicles, ask students the following questions:

- **In this test, we will not push our vehicle down the ramp, but instead place it at the top of the ramp and let it go. Why do you think that we are not going to push it?**
- **In the design challenge, it says that a vehicle has to travel the longest distance down the ramp. How could we determine how far the vehicle travels?**



Explain that a paper roll will be used to measure the distance that each vehicle travels. This will be done by measuring the distance between the end of the ramp to the rear wheel of the vehicle, and then cutting the paper strip with scissors.

Ask each partner team to place their pet inside their vehicle and release the vehicle from the top of the ramp. Measure the distance each vehicle has traveled with the paper roll. Then, privately assign each partner team an identification number to record on their tape.

### Measurement

Once all teams have tested their vehicle and collected appropriate measurements, ask each group to bring their paper strip to the front of the classroom. Secure the tape to a whiteboard or wall, making sure that the bottom of each piece of paper are aligned. Ask the students to assist in arranging the pieces of paper from shortest to longest. Students will use this visual to compare the distances in which each vehicle traveled.

Once all paper strips have been arranged, ask students:

- **What do these pieces of paper represent?**
- **Why are some of the pieces of paper longer than others?**
- **Which three teams' vehicles traveled the longest? How do you know?**
- **Which three teams' vehicles traveled the shortest? How do you know?**
- **Is there a correct answer to this problem? Is there only one way to build a vehicle that moves, or are there many answers? Explain.**

Following this discussion, students may be given the opportunity to refine their design using knowledge gained during the testing phase.

Once all partner teams have completed the design challenge and analyzed their data, debrief the learning experience as a class.

#### Assessment/Debrief Kindergarten Activity:

- *How could we make your vehicle travel a longer/shorter distance? What could we do to the ramp? To your vehicle?*
- *Was it challenging to build your vehicle? Did it take more than one try? How did you feel while you were building your vehicle?*
- *Did you encounter similar challenges as the little girl from the story? Be specific.*
- *Were you being a mathematician/scientist while you were building and testing your vehicle? How? Convince me.*

An optional student page is included in this activity for learners to conduct their “Final Report”. This document may be used to encourage student reflection, debrief, and assessment.

#### First Grade Activity

##### Objectives:

- Meet an engineering design challenge through defining a problem, developing possible solutions, and testing solutions.
- Quantify the distance in which a vehicle travels using measurement and data techniques.
- Evaluate competing solutions by comparing distance traveled.

##### Standards:

NGSS: K-2.ETS1-3, K-2.ETS1.A, K-2.ETS1.B, K-2.ETS1.C, SEP1, SEP2, SEP3, SEP4, SEP7, SEP8

CCSS *Mathematics*: 1.MD.A.1, 1.MD.A.2,

##### *First Grade Activity*

##### **Materials:**

*For each partner team:*

- Assortment of *Brickyard Building Blocks* or similar item
- 1 Dog Animal Figure
- Materials to construct a ramp at student desks
- 1 Food Basket or similar item
- Additional Materials for Vehicle Building (optional)
- 1 Small Post-It Note

*For the teacher:*

- Copy of *The Most Magnificent Thing*
- 2 Testing Ramps
- 1 Paper Roll
- Masking Tape
- Document Camera (optional)

**Note:** Teacher resources may be downloaded for this activity at:

**[goo.gl/5yX5Yd](http://goo.gl/5yX5Yd)**

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## NOTES

MP1, MP2, MP4, MP5

CCSS ELA/Literacy: SL.1.1

Estimated Time: 135-180 minutes (3, 45-60 minute sessions)

### Advanced Planning:

- Students will use a smaller ramp to explore materials at their desk. Identify several materials that may be used to form this ramp (e.g., a thin textbook propped up with a pencil box) and verify that each partner team has access to these materials.
- Separate the *Brickyard Building Blocks* and if available, additional vehicle building materials, into a sample collection for each partner team. A small food basket or snack bag may be used to contain the collection. Each partner team should receive at least one wheel set, accessory item, body piece, and axle part from the *Brickyard Building Blocks* kit, and a selection of the following:

<b>Dixie Cup</b>	<b>Craft Stick</b>	<b>Q-Tip</b>
<b>Straw</b>	<b>Masking Tape</b>	<b>Glue Dot</b>
<b>Large Index Card</b>	<b>Small Index Card</b>	<b>Round Pasta</b>

- Determine how partner teams will receive their building blocks and additional materials to construct their vehicle.
- Prepare the testing ramps, made of foam board, and place in an open and accessible area of the classroom. One end of each ramp should be placed at a height of approximately eight inches from the floor with the other end preferably placed on a tile or wood floor (non-carpeted). However, you may adjust the height of the ramps as desired. Books, wooden blocks, or other solid materials may be used to prop up the ramps. The important point is to keep each ramp the same height off the ground. Steep ramps may interfere with the smooth transition of the vehicle from the ramp to the floor.

## Suggested Inquiry Approach:

### Day 1: Storytelling and Material Inquiry (45-60 minutes)

To begin, organize students into a seating arrangement appropriate for reading a picture book aloud. Pose the following introduction questions to the class:

- What do you think this book will be about?
- What characters do you think might be in this book?

Inform students that they will be reading *The Most Magnificent Thing* and listening to a story about a little girl that tries her hardest to make the most “magnificent thing”. The storytelling-questioning strategy listed in *Activity 1: Storytelling* can be used to facilitate student discussion during the read-aloud. At the end of the picture book, take several minutes to discuss the *Activity 1* debrief questions as a class.

In the next segment of the activity, students will work with a partner to complete a hands-on mathematical and scientific investigation. You may choose to pair students based on academic level, behavior, or other indicators.

Once all students are seated in partner teams, turn the picture book *The Most Magnificent Thing* to the last page, and show the whole class the picture of the little girl riding her scooter with her dog in the sidecar. You may wish to circulate around the room or display this image using a document camera.

Ask students the following questions:

- Why do you think the little girl wanted a “magnificent thing” for her best friend, a pet dog?
- Let’s call the “magnificent thing” a vehicle. Do you know any other examples of a vehicle?
- Look carefully at the little girl’s vehicle. What parts of the vehicle help it to move?
- How might these parts of the vehicle work together?

Distribute student pages to each learner. Read aloud the introductory paragraph found in the grey box at the top of the first student page.

Ask, “Can someone please share what each team is being asked to do?”

NOTES

To encourage positive group work, students may utilize the *Working with a Buddy* card.



# Dare to Tinker

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Verify that all students understand that they will be participating in a design challenge. If necessary, relate this idea back to the book *The Most Magnificent Thing* and review the engineering design challenge as experienced by the little girl. To complete this design challenge, students must construct a vehicle that carries a pet dog the longest distance down a ramp. Verify that students understand the dog must stay in the vehicle as it moves and cannot be secured inside the vehicle with tape or any other material.

Students will begin the investigation by evaluating the materials that may be used to construct their vehicle. A ramp will be utilized to test various materials on an incline. Ask students to retrieve the materials that will be used to construct a ramp. Model how to arrange the materials.

Provide each partner team with a bag of sample materials. Ask students to carefully remove the sample materials from the bag and lay them out on their desk.

At this time, ask students to locate a specific piece of their sample materials. **Note: Do not refer to an item as an “accessory” or “wheel”, but instead, select a piece and hold it up for students to view.** Instruct learners to take turns moving the item around on their desk and down the ramp. Encourage them to move the items in as many ways as possible. As students are working, pose the following questions for class discussion:

- How does your \_\_\_\_\_ piece move on the table?
- How does your \_\_\_\_\_ piece move on the ramp?
- What do you think is making your \_\_\_\_\_ piece move?

Students should investigate each sample material item, answering the previous questions for each tested object.

Once all objects have been investigated, instruct each partner team to discuss the following:

- How do you think these materials could be used to build a vehicle that will carry a dog down the ramp?
- When you build your vehicle with these materials, do you think there is a right way and wrong way to use them?

Allow time for partner teams to discuss the answer to these questions. Then, provide adequate time for volunteers to share their ideas with the class.

**Note:** If additional vehicle building materials are available, the *Wheel and Axle Ideas PowerPoint* (see Second Grade Activity) may be helpful in assisting students with their design.



Day 2: Design Challenge (30-45 minutes)

Next, partner teams will work collaboratively to determine the specific materials that will be used to construct their vehicle. Instruct learners to sketch a picture of their brainstormed design in the appropriate section of their student pages prior to obtaining any materials.

At this time, direct partner teams to begin piecing together materials to build a vehicle that will carry a dog the longest distance down a ramp. While students are working, circulate the room to assist learners, informally assess understanding, the use of fine motor skills, and students correctly utilizing their tools.

Once it is evident that most partner teams have constructed an initial vehicle prototype, ask all groups to step away from their materials and take several minutes to talk about their progress. At this time, partner teams that are struggling may gain insight and potential design solutions from their peers. Suggested discussion questions include:

- **Tell me about how you and your partner are using the materials.**
- **Is anyone experiencing a challenge? How can we help?**
- **Did anyone's partner have a great idea you would like to share?**
- **What is something new that you are thinking about trying?**

Encourage students to continue their work. If necessary, provide frequent updates regarding the amount of time left to work.

Day 3: Final Testing and Measurement (45-60 minutes)

Ask all partner teams to bring their vehicle to the testing ramps. Before testing the vehicles, ask students, **"In the design challenge, it says that a vehicle has to travel the longest distance down the ramp. How could we determine how far the vehicle travels?"**

Explain that a paper roll will be used to measure the distance that each vehicle travels. This will be done by measuring the distance between the end of the ramp to the rear wheel of the vehicle, and then cutting the paper with a pair of scissors.

Ask each partner team to place their dog inside their vehicle and release the vehicle from the top of the ramp. Once a team's car has come to rest, hand one partner the roll of paper tape and instruct the team to unroll the paper from the edge of the ramp to the back tire of the vehicle. Cut the

## Dare to Tinker

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paper strip with scissors. Instruct each partner team to return to their table with their tape.

Students will now conduct a series of measurement techniques to evaluate the performance of their vehicle compared to that of their peers.

Inform students that they will now form a larger group of six students by joining three partner teams together. Students do not have to rearrange their desks and seats, but should find an area of the classroom to work collaboratively. Ask these students to lay their paper strips out on their table or work space.

Students will begin comparing the lengths of the paper strips by first completing a sketch of each partner team's paper in the space provided on their student pages. Next, students will identify which of the three paper strip measurements is *long*, *longer*, and *longest*.

Ask all students to return to their original seat with their partner. Next, students will quantify the length of their paper strip using a non-standard unit: the pet dog (animal figure).



Allow time for students to **ESTIMATE** the length of their paper strip in pet dogs. First, students will record an estimate that they know is too high, and then determine an estimate that they know is too low. Students should then write their “just right” estimate. Students can then share their estimates with their partner, making sure to justify their reasoning.

Students will now remove their pet dog from the vehicle and determine a method to accurately measure the length of the cash register paper strip. The instructor may encourage students to use a “tail to nose” method, which allows students to mark along their strip of paper “units” of animal figure lengths.

**Note: Students are asked to measure approximately half of their paper strip, pause, and reconsider their initial estimate. At this time, students may change their estimate on their student page, but should be able to provide an explanation of why they felt this was necessary.**

As students finish measuring the length of their paper strip, instruct partner teams to remove and dispose of any “leftover” paper that cannot be measured with a whole pet dog. Then, distribute a small Post-it note to each team and ask them to record the number of pet dogs that were used to measure their paper strip and secure the Post-it note onto the paper.



Finally, ask each partner to bring his or her paper strip to the front of the classroom. Secure the tape to a whiteboard or wall, making sure that the bottom of each piece of paper are aligned. Students will use this visual to compare the distances in which each vehicle traveled.

Once all paper strips have been arranged, ask students the following questions:

- **What do these pieces of paper represent?**
- **Why are some of the pieces of paper longer than others?**
- **How well did you estimate the length of your paper strip?**
- **Which three teams' vehicles traveled the longest? How do you know?**
- **Which three teams' vehicles traveled the shortest? How do you know?**
- **How much further did the longest vehicle travel than the shortest vehicle?**
- **Did any vehicles travel the same distance? Which vehicles? How do you know?**

For the teams with the longest and shortest distance traveled, collect the vehicles and ask the class to make observations about the designs. Then, prepare for a whole class debriefing session.

#### **Assessment/Debrief First Grade Activity:**

- *If you had more time to make changes to your vehicle, what would you do? Why?*
- *Is the vehicle that traveled the longest distance the "best" vehicle? What else might we consider?*
- *Did you encounter similar challenges as the little girl from the story? Be specific.*
- *Were you being a mathematician/scientist while you were building and testing your vehicle? How? Convince me.*

Following this discussion, students may be given the opportunity to refine their design using knowledge gained during the testing phase.

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### Second Grade Activity

#### Objectives:

- Meet an engineering design challenge through defining a problem, developing possible solutions, and testing solutions.
- Evaluate competing solutions by comparing distance traveled.
- Evaluate competing solutions by comparing cost.
- Understand the need for using a standard unit of measure by attempting to communicate equivalent lengths in “non-standard” units using animal figures.

#### Standards:

NGSS: K-2-ETS1.A, K-2-ETS1.B, K-2-ETS1.C, SEP1, SEP2, SEP3, SEP4, SEP5, SEP6, SEP8

CCSS *Mathematics*: 2.MD.A.1, 2.MD.A.2, 2.MD.A.3, 2.MD.A.4, 2.MD.C.8, MP1, MP2, MP4, MP5

CCSS *ELA/Literacy*: SL.2.1

Estimated Time: 300 Minutes (5, 60-minute sessions)

#### Advanced Planning:

- Prepare the testing ramps, made of foam board, and place in an open and accessible area of the classroom.

**Note:** Teacher resources may be downloaded for this activity at:

[goo.gl/5yX5Yd](http://goo.gl/5yX5Yd)

#### *Second Grade Activity*

##### **Materials:**

###### *For the class:*

- Approximately 50 - 100 of each “store” item from table
- Approximately 400 plastic quarters
- Approximately 200 plastic dimes
- Approximately 200 paper dollar bills
- 2 Testing Ramps
- Paper roll (register tape)
- Post-it note sheets (1 pad)

###### *For each partner team:*

- Animal figure
- Ruler
- Scissors
- 2 - Small plastic bags
- Copy of Student Pages

###### *For the teacher:*

- Copy of *The Most Magnificent Thing*

- Use the following table for a suggested list of materials and their associated costs. Feel free to add or remove materials as desired. Masking tape must be “purchased” in 12-inch pieces.

Axles	Wheels	Chassis	Seat
Cotton Swab 10¢	Pasta wheels 10¢	Jumbo craft sticks \$1.00	Dixie cups \$1.00
Jumbo straw \$1.00	Mint candies 10¢	3” x 5” index cards 25¢	Soufflé cups \$1.00
Drinking straw 50¢	Wooden spools 50¢	5” x 8” index cards 50¢	Medicine cups 50¢
Cocktail straw 25¢	Wooden wheels 25¢	Chenille stems 10¢	Tape (12”) \$1.00

- Decide which materials you will provide students to investigate wheel and axle systems.
- Decide where to locate the “store” for students to select items for use in building their animal transport vehicle design.
- View the “Sample Store” PowerPoint for suggestions on how to set up the store for student use.
- Pre-cut several 12” strips of masking tape for partner teams to “purchase”.
- Pre-cut a 12-inch strip of paper from the paper roll to use in estimation activity.
- Decide how students will store their student pages to reference during the activity.

### Suggested Inquiry Approach:

#### Day 1: Storytelling and Design (60 minutes)

To begin, read aloud the book *The Most Magnificent Thing* to students. The storytelling-questioning strategy listed in *Activity 1: Storytelling* can be used to facilitate student discussion during the read-aloud. Some additional questions to ask students before introducing the activity are:

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- The little girl in *The Most Magnificent Thing* designed and built a vehicle for her pet to travel with her. What parts of the vehicle help it to move? How might these parts work together?
- What other parts are necessary for the vehicle to transport her pet?

Next, group students into partner teams and distribute copies of the “Day 1” student pages to each partner team. Read aloud the information in the gray box at the top of the first student page.

Ask, “Can someone please share what each team is being asked to do?”

Be sure student teams understand that they will be participating in a design challenge. This challenge asks them to create a vehicle to transport a pet down a hill a **distance of at least twelve inches past the bottom of the ramp**. Students will be measuring from the end of the ramp to the back end of the vehicle.

To complete this challenge, student teams will have to consider how to ensure the vehicle rolls down a ramp without the pet animal figure falling out of the vehicle. **Let students know that they cannot simply tape their pet to the vehicle!** At this point, provide one plastic animal figure to each team.

The twelve-inch distance is the minimum distance that the vehicle will need to travel past the end of the ramp to complete the challenge. However, students will also be comparing total distance traveled to evaluate competing designs. An additional goal of this design challenge is to build the vehicle **without spending a lot of money on materials**.

Partner teams should begin brainstorming potential designs for their vehicles. Encourage teams to draw a sketch of their vehicle.

### Debrief Day 1:

Partner teams may share their sketches by using a document camera or by allowing teams to gallery walk to observe the work of other teams.

To encourage positive group work, students may utilize the *Working with a Buddy* card.



Day 2: Wheel and Axle Systems (60 minutes)

Group students into teams of four for this part of the activity. Set up the ramps in an accessible location in the classroom.

Ask students:

**Yesterday you designed a magnificent vehicle for your pet. How is your vehicle going to move?**

Students should respond that their vehicle must roll down a ramp.

Pass out the “Day 2” student pages. Choose one student to read aloud the background information at the top of the first page. Next, provide time for students to draw several examples of wheel and axle systems. Some examples students may draw include a wheelbarrow, rolling pin, door knob, car axle, spinning top and a cart.

Ask students:

- **What materials might you use as wheels?**
- **What materials might you use as axles?**

Provide student teams with a bag or tray of materials that you have selected as potential wheels (mints, wooden wheels, spools, round pasta, etc.) and axles (cotton swabs, straws of varying sizes). Allow time for teams to construct different wheel and axle systems. They may test using the foam ramps or by constructing a ramp at their tables using books and folders. Encourage careful observation of the way each system moves.

If desired, a slide showing some possible wheel and axle combinations can be shown (see *Wheel and Axle Ideas PowerPoint*). Ask students to describe how the wheel and axle system moves. For some examples, the axle does not rotate when the wheel turns (like a wheelbarrow) and for other examples, the wheels and axle rotate together (like a toy car).

Provide some masking tape and index cards to teach team. Ask student teams to determine how a wheel and axle system might be attached to the body of a vehicle.

**Debrief Day 2:**

- ***How do different wheel and axle systems move?***
- ***How might you attach a wheel and axle system to other parts of your vehicle?***

**Note:** A sample PowerPoint slide for wheel and axle assemblies can be found at:

**[goo.gl/5yX5Yd](http://goo.gl/5yX5Yd)**

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**Note:** A sample store PowerPoint slide can be found at:

[goo.gl/5yX5Yd](http://goo.gl/5yX5Yd)

Students should write their names on each of their baggies.

### Day 3: Materials and Shopping (60 minutes)

Provide each partner team two plastic baggies. Set up the store.

Show students the location of available materials at the store, and discuss with students how they will gather their materials. Students will notice that there is an associated cost of purchasing materials.

Students may now consider which materials they would like to use in building their vehicle. Display a PowerPoint or other photo display of the items you will have for student use in constructing their vehicles. Spend time going through the items. Ask students to share their ideas on how each of the items could be used to build a vehicle for their pet.

Pass out the “Day 3” student pages. Direct students to record the items they want to “purchase” from the store on the shopping list section of their student pages. Inform students that once they buy an item, it cannot be returned. Therefore, planning is very important at this stage. Share with students that tape must be purchased in 12-inch strips.

At this point, introduce the different pieces of money and ask students about the value of the coins shown on the second student page.

**NOTE:** To help students work with the concept of money, they will use their baggie to collect coin and/or dollar bill manipulatives that represent the cost of each item they choose as a building material. For example, if they choose to use a wooden wheel, they would take one plastic quarter and add to their bag. After they have completed their design and “purchased” all materials, students can count the coins and bills to determine a total cost for their vehicle. This value will be used to compare the performance of different vehicles.

Remind students that part of the original challenge was to keep the cost of the vehicle low.

Student teams can come to the store one at a time once their shopping list is complete to select materials to build their vehicle. One student will place “purchased” items into one plastic baggie. The other will collect the appropriate coins or bill representing the item’s cost in another baggie.

### **Debrief Day 3:**

- ***How are you going to use your purchased materials to build your vehicle?***
- ***How will you and your partner work together to build the vehicle?***

Day 4: Build and Test (60 minutes)

Students will be working in their partner teams for this part of the activity. Pass out student materials and money baggies from the previous day, along with that “Day 4” student pages. Provide each student team with a pair of scissors and their plastic pet. Once again, have the store ready for student use.

Read aloud the questions for students to consider before building their vehicle on the top of the first student page.

It is likely that students will struggle with how to attach the wheel and axle component to the body of their vehicle. Productive struggle is encouraged, but if students express significant frustration getting their wheels to turn, you may choose to intervene. Ask the class:

- **What have you tried that did NOT work when attaching the wheels to the body of the vehicle?**
- **What ideas can we try that may help the wheels to spin when they are attached to the body of the vehicle?**

Provide a set time for students to build, test and tinker with their designs. Forty-five minutes is suggested. The use of a projected online timer such as the egg timer from <http://www.online-stopwatch.com/eggtimer-countdown/> may be helpful in keeping students on track.

Place the two ramps in a location that is easily accessible to students. One end of each ramp should be placed at a height of approximately eight inches from the floor with the other end preferably placed on a tile or wood floor (non-carpeted). However, you may adjust the height of the ramps as desired. Books, wooden blocks, or other solid materials may be used to prop up the ramps. The important point is to keep each ramp the same height off the ground. Steep ramps may interfere with the smooth transition of the vehicle from the ramp to the floor.

Encourage students to use the available time to test, modify and retest their designs.

Announce when final testing will begin after teams have had an opportunity to build, test and tinker with their vehicle designs.

Each team will have one trial to roll their vehicle down the ramp starting with the back wheels at the top edge of the ramp. Students should let go



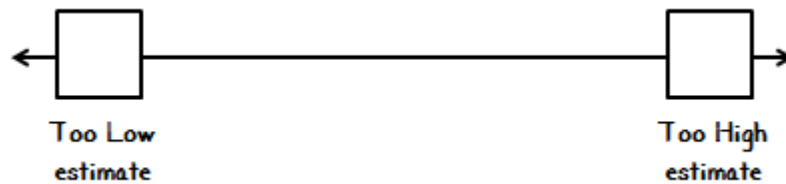
# Dare to Tinker

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of the vehicle and not provide any additional push or pull; gravity should do the work!

Once a team's car has come to rest, hand one partner the roll of paper tape and instruct the team to unroll the paper from the edge of the ramp to the back wheel of the vehicle. They should then cut the strip of paper tape using scissors. Instruct students to write their names on the back of the paper tape.

At this time, ask students to **ESTIMATE** the length of the strip of paper. Do not coach students towards using a particular unit of measure at this time. There is a blank number line on the second student page for students to record their estimates.



Encourage students to choose **reasonable** values for their “too low” and “too high” estimates. Also, ask them to think about where on the number line they should place their “just right” estimate. Most students will simply place this value in the center of the number line. However, even in second grade, students must consider the relative placement of numbers on the number line. You may teach students to find a midpoint between their “too low” and “too high” values to use a guide for placement of their “just right” estimate.

Once students have made their estimates, hold up a strip of paper that has been cut to exactly twelve inches. If desired, students may revise their “just right” estimates based upon this new information.

Students should clean up their areas. Collect the paper strips and money baggies for the following lesson.

### **Debrief Day 4:**

- *Do you think your design met the challenge? How do you know?*
- *What was the most difficult part of this challenge?*
- *Did you ever feel like giving up? What did you do?*

Day 5: Measurement (60 minutes)

Pass out the “Day 5” student pages and each team’s money baggie. Provide each partner team with a pair of scissors and a ruler. Students will also need their plastic pet.

Students are now tasked with measuring their paper strip using three different units: their pet animal figure, inches, and centimeters. Allow students to mark along their paper strip “units” of pet lengths. It is up to the students to determine how they will use their pet to measure the strip. Students may measure to the nearest inch or centimeter using a ruler.

Once all teams have measured their paper strips, reconvene the class for a whole group discussion. Record each team’s measurement data on the board or a piece of chart paper. Ask the following questions.

- **How long is your paper strip when you measured using your “pet”? Can you tell the difference between units of “dogs” and units of “cats” or other figures?**
- **How would I know which is longer – a strip that is 15 “dog” units long or one that is 20 “pig” units long?**
- **How long is your paper strip when it is measured in inches?**
- **Using inches, how can you tell when one paper strip is longer than another paper strip?**
- **How long is your paper strip when it is measured in centimeters? Is the number of centimeters larger or smaller than the number of inches for your paper strip? Why do you think that?**
- **What unit or units should we use to measure the paper strips? Why do you think that?**
- **How well did you estimate the length of your paper strip? What unit did you use?**

Distribute 3–4 Post-it note sheets to each student. Now, ask students to hang their paper strips along a wall in order from shortest to longest, aligning the strips from the top. For the teams with the longest distance traveled, collect the vehicles and ask the class to observe the designs. Write these observations on a Post-it note sheet. Similarly, collect vehicles from teams with the shortest distance traveled and ask students to write observations on the design using Post-it note sheets. Collect and read the different student observations. Discuss why certain design features may help the vehicle travel further.

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Ask students, “Is the vehicle that traveled the longest distance the “best” vehicle? What else might we consider?”

Tell students that they are also going to look at the “cost” of each of the different designs to see if that might impact the decision on which vehicle is “best.” Students should use the space on the second student page to draw a representation of the coins and bills they collected in their baggies from “purchasing” materials. Assist student teams as necessary with the counting and addition of the money. You may choose to show an example to the class such as the following:

Money Type	How many of each type do you have?	What is the value of the money?
Dollars	4	\$4.00 (dollar bills) \$1.00 (4 quarters)
Quarters	13	\$1.00 (4 quarters) \$1.00 (4 quarters)
Dimes	7	25¢ (1 quarter) 70¢ (7 dimes)
Total Cost of vehicle:		\$7.95

Using a Post-it note sheet, have one partner member write the total cost of the vehicle on the Post-it note sheet and then attach the sheet to their paper strip.

### Assessment/Debrief Second Grade Activity:

Students may independently, or in small groups, respond to the following questions. An assessment is located at the end of the student pages for this activity.

- *How much longer is the longest paper strip compared to the shortest paper strip?*
- *What is the most expensive vehicle and the least expensive vehicle?*
- *Which vehicle do you believe is the “best” vehicle? Why? Use class data to support your decision.*

As an independent assessment, you may choose to cut paper strips a given length and distribute amongst students. Before providing them with a measurement tool, ask students to estimate the length of the strip. First, ask the class for an estimate that they know is too high (include the units). Next, ask for an estimate that they know is too low (include the units). Students should then write their “just about right” estimate on the paper strip. Provide students with measurement tools and ask them to measure the paper strip in units of inches and centimeters and then to comment on how well they estimated the length of the paper strip.

### Resources

For a listing of NSTA’s recommended science trade books to use in designing an integrated activity, visit the link at

<http://www.nsta.org/publications/ostb/>

A listing of children’s books with mathematical themes can be found at

<http://www.the-best-childrens-books.org/math-for-kids.html>.

Cox, J. (n.d.). Using Children's Literature to Motivate Math Lessons. Retrieved February 08, 2017, from <http://www.teachhub.com/using-children's-literature-motivate-math-lessons>

Friel, S. N., Curcio, F. R., & Bright, G. W. (2001). Making Sense of Graphs: Critical Factors Influencing Comprehension and Instructional Implications. *Journal for Research in Mathematics Education*, 32(2), 124. doi:10.2307/749671

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NOTES





Name: \_\_\_\_\_ Partner Name: \_\_\_\_\_

## Final Report

Draw your "magnificent thing" below:

A large, empty rounded rectangular box with a thick black border, intended for the student to draw their 'magnificent thing'.

What did you draw?

\_\_\_\_\_

-----

\_\_\_\_\_

-----

\_\_\_\_\_

Did you work well with your partner? 😊 😐 ☹️

# Dare to Tinker

## Kindergarten Activity, Student Pages







Name:

Partner Name:

## Day 1: Storytelling and Materials

The book *The Most Magnificent Thing* tells a story about a little girl. She loves to tinker and create new things...even magnificent things! Her most magnificent thing was a vehicle for her best friend. He can now travel with her on adventures. You and a partner will work together to **design**, **build** and **test** a magnificent vehicle. Your vehicle should carry a pet dog the longest distance down a ramp. The dog must stay in the vehicle during travel!

Test your materials. Think about their use. Which materials will you use to build your vehicle? List them below.



Name:

Partner Name:

## Day 2: Design and Build

Draw your magnificent vehicle.

A large, empty rounded rectangular box with a thick black border, intended for students to draw their magnificent vehicle.



Name:

Partner Name:

## Day 3: Test and Measure

Let's see how well your magnificent vehicle carries your animal!

- ✓ Listen to your teacher's directions. You will be testing your vehicle. You will also measure the distance that it travels.

Sketch the lengths of each team's paper strip below. Then, next to each strip, write which one is long, longer, and longest.



You will measure the length of your paper strip using the pet dog.


### Estimate

✓ What is a number of pet dogs that would be too low?

✓ What is a number of pet dogs that is too high?

✓ What do you think is a “just right” number of pet dogs that will measure the length of the paper strip?

How many pet dogs were used to measure the length of your paper strip? Record your answer below.





Name:

Partner Name:

In the book *The Most Magnificent Thing*, the little girl loves to tinker. She likes to create new things...even magnificent things! Her most magnificent thing was a vehicle she built for her best friend. He could travel with her on adventures. Now, you will work with a partner. Together you will design, build and test a magnificent vehicle. A plastic pet animal will ride on your vehicle. Your vehicle must roll down a ramp. It must travel at least 12 inches past the end of the ramp. You also do not want to spend too much money on materials. Choose wisely!

What parts does your vehicle need to roll down a ramp?

Your pet is a \_\_\_\_\_.

What parts does your vehicle need to hold your pet?

Dare to Tinker  
Second Grade Activity, Student Pages

Page 2 of 2



Day 1: Design

Draw your magnificent vehicle below.

A large, empty rounded rectangular box with a thick black border, intended for a student to draw their magnificent vehicle.

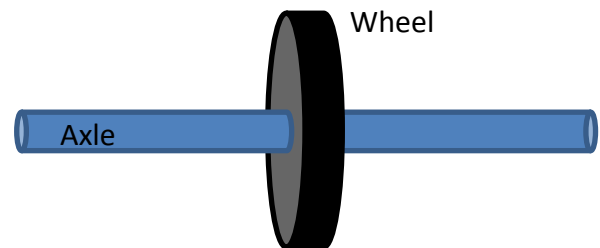


Name:

Partner Name:

## Day 2: Wheel and Axle

An **axle** is a rod that goes through a wheel. An axle may also attach two wheels together. The axle allows the wheel to turn.



Draw some examples below.



## Explore

Your teacher will give you some materials. Make different wheel and axle systems. Take them to a ramp. Observe how they roll.

Draw or write your observations below.



**THINK:** How can you attach your wheel and axle system to your magnificent vehicle?





Name:

Partner Name:

## Day 3: Materials

Look at the materials in the store. What materials might you use to build your vehicle?

Make a shopping list below.





## Cost

How much money is shown in the pictures below?



## Go shopping

- ✓ Each item in the store has a cost.
- ✓ One partner will pick up an item from the shopping list.
- ✓ Place the item in a baggie.
- ✓ The other partner will pick up coins or dollar bills.  
They should equal the cost of the item.
- ✓ Place the money in another baggie.
- ✓ This will help you keep track of your vehicle's cost.





Name:

Partner Name:

## Day 4: Build

- ✓ Can your vehicle roll down the ramp?
- ✓ Does your pet fall out of the vehicle?  
Do not tape the pet to the vehicle.
- ✓ Do you and your partner share the work?



## Test

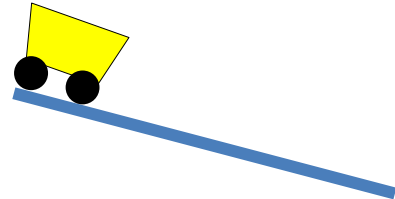
Take your magnificent vehicle to a ramp. Place it so that the back wheels are at the top of the ramp (without hanging over). Let go. Do not give any extra push or pull to the vehicle. How did it work? Record your observations below.



## Final Testing

**CHALLENGE:** Can your vehicle and pet travel at least 12 inches past the end of the ramp?

✓ Roll your vehicle down the ramp.



✓ Wait until the vehicle stops. Get a paper roll from your teacher. Unroll a strip of paper from the bottom end of the ramp to your vehicle's back wheel.

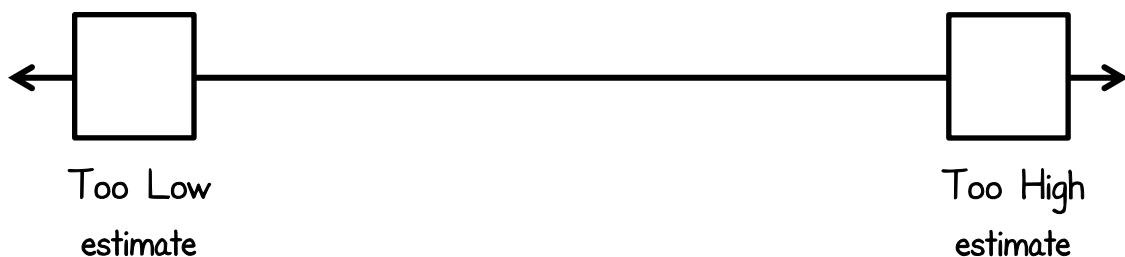


✓ Cut the strip of unrolled paper from the roll.



✓ Write both your names on one side of the paper strip.

✓ **ESTIMATE:** How long is the strip of paper?



*Place your **just right** estimate along the number line. Be sure to label!*

✓ Your teacher will show you a strip of paper that is 12 inches in length. You may revise your **just right** estimate.



Name:

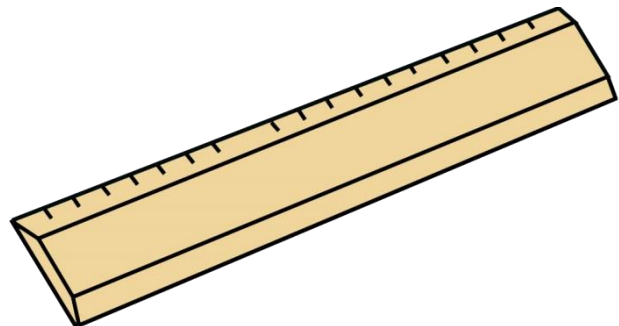
Partner Name:

## Day 5: Data

MEASURE the paper strip. Record your data in the table.

Measure using...	How long is the paper strip?
Your pet	
Inches	
Centimeters	

Use a marker to write your measurements on your paper strip. Don't forget your units! Please write on the blank side. Your names should be on the back.





## Money, Money, Money

You have collected money in a baggie. Count the money.

This money shows how much you spent on materials for your vehicle. Draw a picture to help you count.

Total Cost of vehicle:

Write your total cost on a Post-it note sheet.

Attach the note sheet to your paper strip.





Name: \_\_\_\_\_

## Assessment

1. Compare the estimated length of the paper strip to the measured length.

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2. Did your vehicle meet the challenge? \_\_\_\_\_  
How do you know?

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3. Can you compare lengths measured using pets? \_\_\_\_\_  
Why or why not?

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Answer the following questions using the class data.

4. How much longer is the longest paper strip compared to the shortest paper strip?

5. What is the most expensive vehicle?

6. What is the least expensive vehicle?

7. Which vehicle do you believe is the “best” vehicle? Why?

Use class data to support your decision.