PLOT SUMMARY:

Darrel wants to make cupcakes for his friend's birthday, but he has never baked before!

CUPCAKE CARRIER CHALLENGE:

Problem What problem will you solve?	Challenge What will you do?	Criteria What should the solution do to be successful?	Constraints What are the limits?
Darrel put the cupcakes on a plate and covered them with foil. Some of the frosting stuck to the foil.	Design and build a cupcake carrier.	• The carrier should cover or enclose the cupcake completely. • The carrier should allow you to quickly put the cupcake in and take it out. • When carried through the testing course, the cupcake should remain unchanged.	• Use only the materials given. • You cannot stick anything into the cupcake. • There must not be any frosting stuck to the inside of the cupcake carrier.

OTHER POSSIBLE PROBLEMS AND CHALLENGES:

Students can use the *Universal Challenge Pages* (pages 104–107) to create solutions to any of the problems below or problems they identify themselves.

Problem	Darrel needs to sift the flour.
Possible Challenge	• Engineer a way to sift flour using materials on hand.

Problem	Darrel drops the eggs and some break.
Possible Challenge	• Design an egg carton that protects eggs from breaking when dropped.

Problem	Darrel doesn't have a mixer, so he has to cream the butter and sugar by hand.
Possible Challenge	• Design a device to cream butter and sugar.

MATERIALS:

Required: cupcakes with frosting (If you cannot use actual cupcakes, create cupcake shapes from clay or salt dough and top with shaving cream "frosting.")

Suggested: container materials such as plastic cups and bowls, empty food containers, small cereal boxes; structural materials such as craft sticks, toothpicks, straws, cardboard; connecting materials such as tape, pipe cleaners, rubber bands

PREPARATION:

Set up a testing course for students to walk through while carrying their cupcakes. The more obstacles you add, the harder it will be for the cupcake to make it through unchanged! Some ideas for obstacles: go over a chair, go under a table, turn around in place three times, hop or jump along a masking tape line. Students can help set up the course.

LESSON PLAN:

1. Have students read the passage and discuss the problems they identified. Use these questions as prompts:
   - Have you ever baked anything? How did it go? What problems did you have? How did you solve them?
   - Did Darrel have problems in this story? How did he solve them?
2. Introduce the Cupcake Carrier Challenge by reading through the challenge pages together. Show students the available materials and review the criteria and constraints. Demonstrate (or have a student demonstrate) how they should walk the testing course.
3. Emphasize the criteria that the cupcake holders must allow the cupcakes to be put in and taken out quickly. Students can't close their carrier permanently once the cupcake is inside!
4. Give students time to prepare, brainstorm, plan, and build their cupcake carriers. Circulate to observe and answer questions as students work on their solutions. Remind them to use the challenge pages to guide them as they work through the engineering design process.
5. Have students share their solutions with the class and get feedback from peers, then revise their designs and test again.
6. When students have completed the challenge, have them explain their cupcake carrier designs to the class and demonstrate by walking the course. Then have them fill out the reflection page.
7. If time, allow students to choose their own problem and testing setup and use the *Universal Challenge Pages* (pages 104–107) to complete their challenge.

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Directions: Read the passage and underline the problems the character has to face. Write and/or sketch your ideas for solutions in the margins.

BIRTHDAY BAKER

Darrel thought it would be great to make cupcakes for his friend Corbin's birthday, but he had never made cupcakes before. He had his grandma's recipe for chocolate cupcakes with chocolate frosting. He knew Corbin loved chocolate. Darrel took a deep breath and decided to give it a try.

First, he needed to measure out the ingredients. The recipe said, "Two cups of flour, sifted." What did that mean? He went to his computer and searched "how to sift flour." He learned that *sifting* means "shaking the flour through a screen." This breaks up any lumps and makes the flour lighter and easier to mix into the other ingredients. Only one problem: he didn't have a sifter. He measured out two cups of flour and stirred it a bit with a fork to break up the lumps.

The recipe called for two eggs. Darrel took a carton of eggs out of the refrigerator. As he turned to place the carton on the counter, he didn't notice his dog, Coco, behind him. He tripped over Coco, who bolted out of the kitchen. The entire carton of eggs flew out of Darrel's hand and landed on the floor. Oh, no! Thankfully, only some of the eggs broke. Darrel still had the two he needed for the cupcakes.

Once he had all the ingredients ready, Darrel moved to the instructions. He mixed together the flour, baking powder, cocoa, and salt in a bowl. Then, he read, "Cream together the butter and sugar until light and fluffy." Hmmm. Cream wasn't on the ingredient list. A quick search told him that it means to mix ingredients together quickly so little air pockets form. This makes the cupcakes fluffy. He also read that if he had an electric mixer, it would take three minutes to cream the butter and sugar. He didn't have a mixer, so he would have to cream the butter and sugar with a wooden spoon, which would take 20 minutes. By the time he was done, his arm was aching.

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BIRTHDAY BAKER

He stirred the eggs into the batter, one at a time, and then the vanilla. Then he stirred in the flour mixture. Lastly, he set cupcake wrappers into a muffin tin and spooned batter into each wrapper. He put the cupcakes in the oven and set the timer. Then he breathed a sigh of relief.

Finally, the timer sounded and the cupcakes were done. As Darrel took them out of the oven, he thought they looked pretty good. He was very glad that he had bought a can of pre-made frosting. But how to get it onto the cupcakes? He searched again and found that most bakers use a piping bag to squeeze frosting on in nice patterns. He didn't have a piping bag. So he did the best he could with a spatula. He scooped out some frosting and sort of smooshed it around on each cupcake.

He put the finished cupcakes on a plate and wrapped foil over the top. When he got to Corbin's house, he wished him a happy birthday. As Corbin took the foil off of the cupcakes, Darrel could see that a lot of the frosting had stuck to the foil! Corbin didn't seem to mind. He got a butter knife and scraped some frosting off the foil and smooshed it onto a cupcake. He said it was delicious, and the smile on his face made Darrel believe it.

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STEP 1: PREPARE FOR THE CHALLENGE

Problem What problem will you solve?	Challenge What will you do?	Criteria What should the solution do to be successful?	Constraints What are the limits?
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Before you start designing your cupcake carrier, walk the testing course. Pay attention to each section of the course and think about what might happen to the cupcake as you are carrying it.

1. Which section of the course do you think will be the most difficult to go through without damaging the cupcake? Why?

_____

_____

_____

2. What does your cupcake carrier need to do to keep your cupcake safe in this section of the course?

_____

_____

_____

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STEP 2: BRAINSTORM, PLAN, AND BUILD

1. Brainstorm design ideas for cupcake carriers you can build that will meet the criteria and constraints. Sketch and write at least three ideas on the back of this page.
2. Think about which design might perform best in testing. Draw a star by the design you will build. Why did you choose this idea?

_____

_____

_____

3. Draw a diagram of your design here. Label all of the materials.

4. Describe how your cupcake carrier will keep your cupcake safe throughout the testing course.

_____

_____

_____

5. Build your cupcake carrier!

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STEP 3: TEST, IMPROVE, AND SHARE

1. Test your cupcake carrier. Put a cupcake in your carrier and go through the testing course holding your carrier. At the end of the course, check your cupcake. Did your cupcake carrier keep your cupcake safe? If not, what do you think went wrong?

2. How could you improve your design?

3. Share your cupcake carrier with classmates. How can you use their ideas to make it better?

4. Keep testing and improving until your cupcake carrier passes the test!

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STEP 4: REFLECT

1. How does your design keep the cupcake safe?

2. How did your cupcake carrier perform the first time you tested it?

3. How did you improve your design?

4. What was the hardest part about this challenge?

5. What have you learned from this challenge?