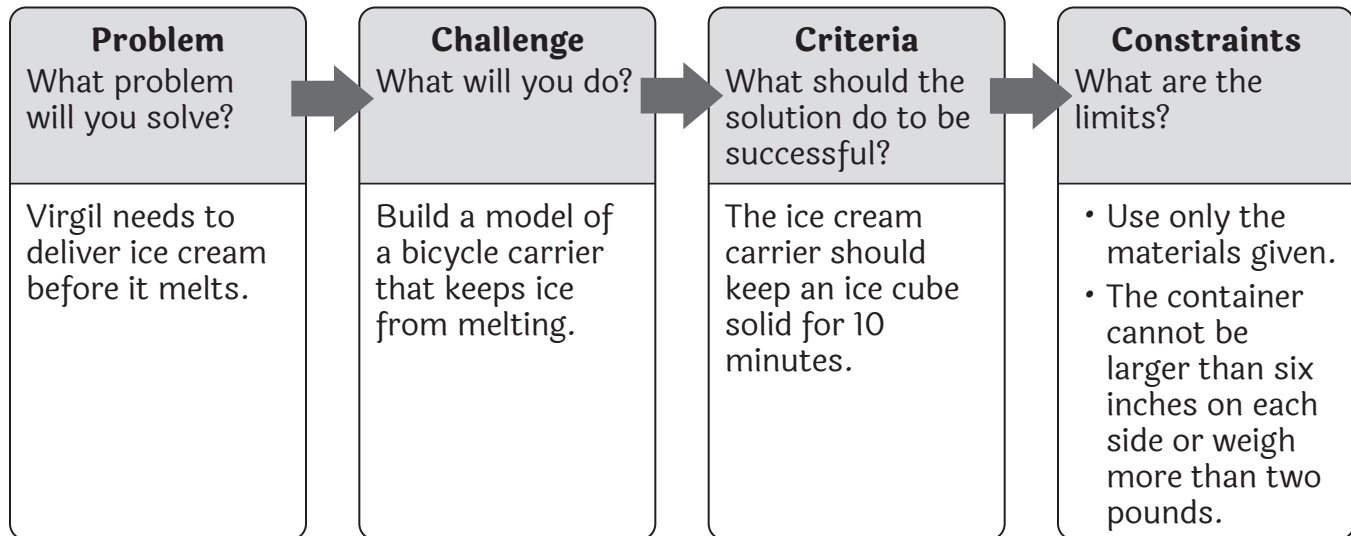


PLOT SUMMARY:

Virgil wants to earn money delivering packages on his bike, but things don't go as planned.

ICE CREAM CARRIER CHALLENGE:



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	Virgil needs to carry more on his bike.
Possible Challenges	<ul style="list-style-type: none"> • Build a trailer that he can tow behind the bike. • Create more ways/places to carry things on the bike.
Problem	Virgil needs a way to carry things that are too long or wide for the rack and basket.
Possible Challenge	<ul style="list-style-type: none"> • Create a device or system for carrying oversized packages.
Problem	Stopping to check the map app adds time to each delivery.
Possible Challenge	<ul style="list-style-type: none"> • Design a mount for the phone on the handlebars.
Problem	Virgil gets soaked riding in the rain.
Possible Challenge	<ul style="list-style-type: none"> • Create something to keep him dry as he rides.

MATERIALS:

Required: ice cubes, paper plates

Suggested: insulating materials such as aluminum foil, plastic wrap, wax paper, bubble wrap, felt, fabric, cotton balls; containers such as cardboard boxes, plastic bottles, cans; connectors such as string, tape, glue

PREPARATION:

Designate a table or desk as the testing area. You will need ice cubes for testing. These should be full-size ice cubes rather than small nuggets or flakes. For the initial test, students will need paper plates.

LESSON PLAN:

1. Have students read the passage and discuss the problems they identified. Use these questions as prompts:
 - Have you ridden a bicycle? Did you carry anything while you were riding? How did you carry it?
 - What did Virgil want? How did he think he could make the money he needed?
 - What are the problems Virgil encountered in making deliveries by bicycle? Did he solve any of them? How?
2. Introduce the Ice Cream Carrier Challenge by reading through the challenge pages together. Show students the available materials and review the criteria and constraints. Explain to students that they will be using ice cubes instead of ice cream because no one wants to waste ice cream!
3. Have students perform the ice cube test first. Discuss the concept of a *control* (ice cube by itself) to which they can compare the ice cubes they are testing. Have all students or groups share their results of this test and compile the results in a class chart on the board or chart paper. As a class, discuss how students can use the test results to inform their build.
4. Give students time to prepare, brainstorm, plan, and build their ice cream carrier models. 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 show and explain their ice cream carriers for the class. 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.

NAME: _____

DATE: _____

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

SPECIAL DELIVERY

Virgil needs money. Specifically, he needs \$300 to buy a new video game console so he can play the newest release of his favorite game, *Crazy Crash Cousins 3*. Well, maybe *need* isn't the right word, but he definitely *wants* it. So he starts thinking about how he can earn the money.

His friend's older sister, Jamie, delivers packages and groceries for the online company Nile, and she makes pretty good money. But Jamie has a car, and Virgil has a bicycle. Could he make deliveries using his bike? It could be tricky, but at least he wouldn't have to pay for gas. He decides to give it a try.

First, Virgil downloads the Nile delivery app to his phone. It will tell him where packages are to be picked up and delivered, and he can put the addresses in a map program and get turn-by-turn directions.

Next, he needs to figure out the best way to carry packages. His bike has a rack above the back wheel that can hold up to 20 pounds. The wire basket on the front of the bike can carry another 15 pounds. He could carry extra-long or -wide items if he can find a way to hold them or attach them to the bike. He could carry even more if he could tow some behind him. He decides to try a few deliveries with his bike as it is.

Virgil logs in to the app and his first delivery looks easy. He straps on his helmet and rides to the Nile pickup station. He picks up two small packages and they fit perfectly in the basket on the front of his bike. He enters the delivery address in the map program and looks at the route, which will take him about nine blocks with a few turns along the way. He puts his phone in his back pocket and sets off.

At the first turn, Virgil can't remember which direction to go. He stops at the side of the road, pulls out his phone to check the directions, puts his phone back in his pocket, and starts on his way again. He has to stop two more times to check the map before he arrives at his destination and delivers the packages. He's pretty satisfied with his first delivery job, but it did take longer than he expected.

NAME: _____

DATE: _____

SPECIAL DELIVERY

Virgil checks the app for his next delivery and cycles to a different Nile pickup station. This package is big and heavy. As Virgil struggles to lift it, he worries that he won't be able to carry it on his bike. He sees that the delivery address is just two blocks away. So he heaves the box up onto the seat of his bike, puts one hand on the handlebars, steadies the package with the other hand, and walks the bike. By the time he arrives at the delivery address, he's sweating. He glances at the app again—the apartment number is 205. Second floor? Oh, no. He looks around for an elevator, but no such luck. He manages to get the package up the stairs and down the hall to 205, but just barely. Maybe this delivery job isn't going to be so great after all.

Virgil checks the app for his next delivery and sees that it's a grocery order. He slaps his hand to his forehead. "Ten pints of ice cream?!" he shouts. They need to be delivered two miles away, so the ride will take him about 10 minutes. He thinks about how he could possibly make this work. If the ice cream is melted when he delivers it, not only will he not get a tip, but he'll have to refund the customers' money as well. He lets out a big sigh as he cancels the delivery job on the app.

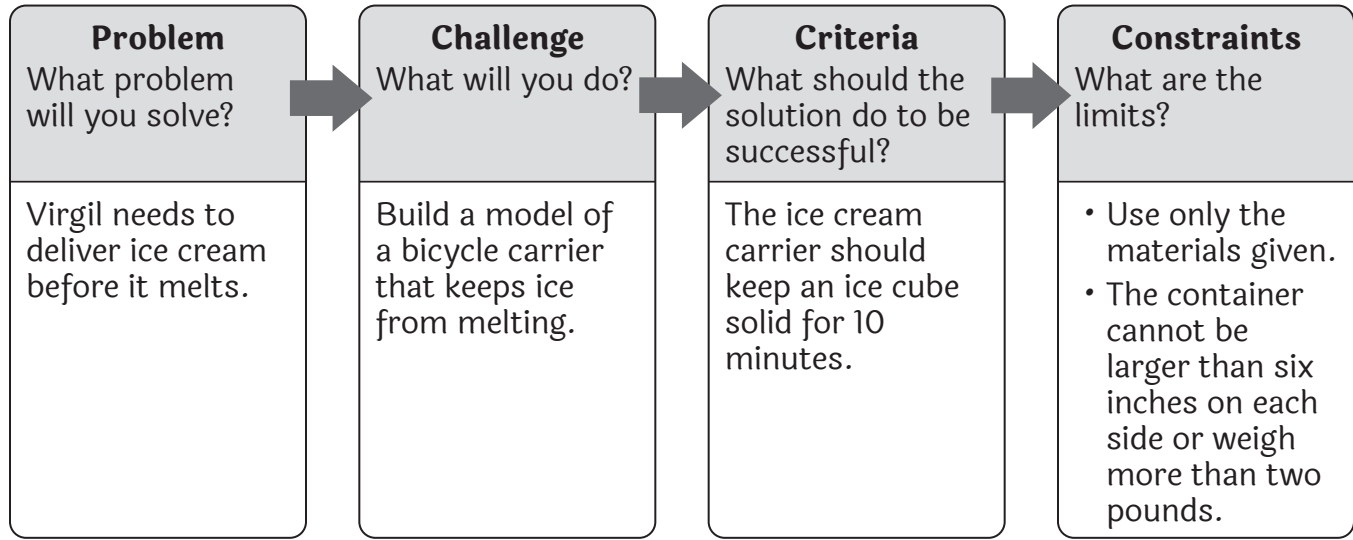
As he cycles back home, the clouds open up and rain pours down. Poor Virgil. This delivery job just isn't working out the way he planned.



NAME: _____

DATE: _____

STEP 1: PREPARE FOR THE CHALLENGE



Directions: Read the information below and answer the questions.

- Heat always moves from a warmer area to a colder area. What happens if you hold an ice cube in your hand? The heat from your hand moves into the ice and makes it melt. To keep ice solid, you need to keep heat away from it.
 - Materials through which heat moves easily are called *conductors*.
 - Materials that do not let heat pass through easily are called *insulators*.

Which kind of material do you want to use in your ice cream carrier model? Why?

- Choose four materials and test to find out how well each material keeps an ice cube from melting. Cut pieces of material that are each the same size and wrap each around an ice cube. Set all of the ice cubes in the sun or a warm place, along with an ice cube on a paper plate as a *control*. Check the ice cubes at the intervals in the table below and record your observations.

Material	1 minute	5 minutes	10 minutes
Control (no wrap)			

- Which material worked the best to keep the ice from melting? _____

What is your evidence? _____

NAME: _____

DATE: _____

STEP 2: BRAINSTORM, PLAN, AND BUILD

1. Brainstorm design ideas for ice cream 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 ice cream carrier will keep ice from melting.

5. Build your ice cream carrier according to your plan!

NAME: _____

DATE: _____

STEP 3: TEST, IMPROVE, AND SHARE

1. Place your ice cream carrier in the testing space. Put an ice cube in your model, close it, and leave it for 10 minutes. Did the ice cube stay solid? If not, how could you improve your design?

2. Share your ice cream carrier design with classmates. How can you use their ideas to make it better?

3. Keep redesigning until your ice cream carrier meets the criteria!

NAME: _____

DATE: _____

STEP 4: REFLECT

1. How does your design stop or slow the melting of an ice cube?

2. How did you improve your design?

3. How could you use what you learned in this challenge to build a full-size carrier for Virgil's bike?

4. What was the hardest part about this challenge?

5. What have you learned from this challenge?
