PLOT SUMMARY:

Finn and his friend Morgan build an awesome treehouse.

TREELESS TREEHOUSE 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?
Morgan wants to build a treehouse but doesn't have a big tree in his yard.	Plan and build a model treehouse that doesn't need a tree.	• The model treehouse must be raised above the ground and stand up by itself. • The solution should include at least one way to get in and out of the treehouse. • The solution should protect the treehouse from the elements. • Add at least two extra, fun ideas to your treehouse. • Label dimensions on the plan and the model.	• Use only the materials given. • Model may be no larger than two feet on any side.

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	Finn and Morgan don't have very much money to build a treehouse.
Possible Challenge	• Design a treehouse built only with recycled materials.

Problem	They need to make the treehouse deck safe.
Possible Challenge	• Design a railing system or another way to keep people safe on a treehouse deck.

Problem	The rope and pulley system with a bucket doesn't haul up very much at once.
Possible Challenge	• Design a system to haul up bigger loads.

MATERIALS:

Required: graph paper

Suggested: structural items such as craft sticks, straws, unsharpened pencils, cardboard tubes; containers such as cardboard boxes, plastic milk or egg cartons, paper or plastic cups; assorted papers such as index cards and construction paper; malleable materials such as felt, fabric, aluminum foil, clay; connectors such as glue, tape, rubber bands, yarn; paint and paintbrushes

PREPARATION:

Provide teams with graph paper for their plans. While students will not be testing their designs in this project, you will need a space for them to display their models so that everyone can examine them and give feedback.

LESSON PLAN:

1. Have students read the passage and discuss the problems they identified. Use these questions as prompts:
   - Have you ever been in a treehouse? Have you seen one in books, TV shows, or movies?
   - What are some things you know about treehouses?
   - What are some of the challenges Finn and Morgan faced in building their treehouse?
2. Introduce the Treeless Treehouse Challenge by reading through the challenge pages together. Show students the available materials and review the criteria and constraints.
3. Once students have completed the first page of the challenge, discuss 1:12 scale and have the class compare their drawings of a chair and a desk. Explain to students that using 1:12 scale will help keep their models in proportion so that they look like real treehouses.
4. Explain to students that they will draw a plan of their model on graph paper in 1:12 scale, and they need to include measurements in their designs. They should label the full height and width of their treehouse model, and the height of the deck above the ground. They can include any other measurements they think will help them as they build their model.
5. Explain that in addition to the required criteria, students should include at least two additional fun features for their treehouse models. Some ideas: pulley system, climbing wall, swinging bridge, slide, fire pole, mailbox, furniture, hammock.
6. Give students time to prepare, brainstorm, plan, and build their treehouse 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.
7. Have students evaluate their models by checking them against the criteria, share their solutions with the class, and get feedback from peers. Then they should revise and improve their designs.
8. When students have completed the challenge, have them show and explain their treeless treehouse models to the class. Then have them fill out the reflection page.
9. 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 characters face. Write and/or sketch your ideas for solutions in the margins.

THE TREEHOUSE

Two summers ago, Finn and his next-door neighbor Morgan decided to build a treehouse. Morgan was disappointed that the trees in his yard weren't very big, but he was happy to help build a treehouse in Finn's yard that they could both use.

Finn had a little money saved up, but not enough for all new supplies. Morgan's dad was taking apart an old shed, so they recycled the wood for the treehouse. They also got lots of supplies from the scrap yard and neighborhood garage sales.

They chose the biggest tree in Finn's yard. They started by building a large, square deck that was anchored against the tree on the back and had two legs to hold up the front. They added a railing made of fallen branches that Finn collected after a storm. The deck was eight feet off the ground, so safety was important.

On the back half of the deck, they built the shelter. It had a Dutch door in the front and a window in each wall. The windows didn't match because they came from the scrap yard, but Finn liked it that way. Morgan said it gave the building character. For the roof, Finn bought a few sheets of corrugated metal; it was worth the money, as they wanted to make sure the roof didn't leak. They built the roof structure higher in the center and sloping on the sides so the snow could slide off in the winter.

Finn wanted the treehouse to look as natural as possible, so they decided to stain the wood instead of painting it. The stain would also protect the wood from rain and sun damage. They wanted to be sure the treehouse would last a long time, so they were careful to cover every bit.

Finn and Morgan included several ways to get into and out of the treehouse. Underneath, a rope ladder led to a trap door, and there was a slide on one side. They built a series of platforms and a wide ramp connecting them so their friend Casey, who used a wheelchair, could enjoy the treehouse.

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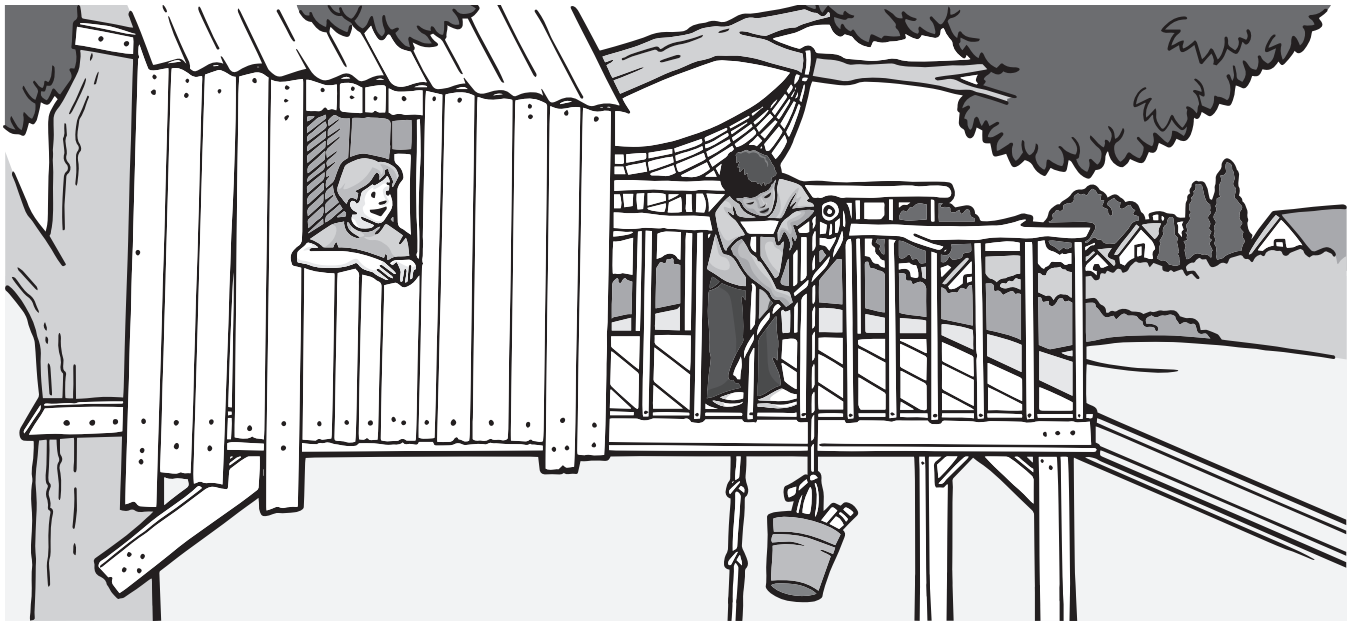
THE TREEHOUSE

Inside, Finn and Morgan built a bench along one wall and Finn's grandma made some cushions for it. They built a bookshelf and stocked it with books and comics, board games, and art supplies. Morgan found an old rug at a garage sale, and Finn's cousin gave them a couple of bean bag chairs when she moved away to college.

Out on the deck, they hung an old hammock from the tree branches. Morgan found a couple of beach chairs at a thrift store. They rigged up a rope-and-pulley system with a bucket so that they could haul things up. It wasn't big enough for anything more than a few snacks, but it was fun.

Finn loved his treehouse all year long. In autumn, the leaves on the tree turned yellow, orange, and red. The light coming through the leaves made the inside of his treehouse glow like a campfire as he and his friends carved pumpkins. In winter, the tree dropped all of its leaves, and snow covered the deck and roof of the treehouse. Finn enjoyed shoveling the snow off the ramps and the deck and inviting friends up for some hot chocolate. In spring, little, green leaf buds popped out at the ends of the branches. Finn loved to check on the tree every morning as the new leaves unfurled and grew. In summer, the heavy, green canopy shaded the treehouse. It was deliciously cool inside—the perfect place to read comics and sip lemonade.



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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?
Morgan wants to build a treehouse, but doesn't have a big tree in his yard.	Plan and build a model treehouse that doesn't need a tree.	• The treehouse must be raised above the ground and stand up by itself. • The solution should include at least one way to get in and out of the treehouse. • The solution should protect the treehouse from the elements. • Add at least two extra, fun ideas to your treehouse. • Label dimensions on the plan and the model.	• Use only the materials given. • Model may be no larger than two feet on any side.

For this challenge, your model should be created in 1:12 scale. This means that one foot of a full-sized treehouse will be represented by one inch on your model. So, if the real treehouse deck is six feet above the ground, you would build your model deck six *inches* above the table.

Directions: Practice using 1:12 scale. Measure some things around you to the nearest foot and convert them to 1:12 scale. Then sketch each model-sized item on the back of this page. Use a ruler!

1. Chair

	Full size in feet (round to the nearest foot)	1:12 scale model size in inches
Height		
Width		

2. Desk

	Full size in feet (round to the nearest foot)	1:12 scale model size in inches
Height		
Width		

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STEP 2: BRAINSTORM, PLAN, AND BUILD

1. Brainstorm design ideas for treeless treehouse models you can build that will meet the criteria and constraints. Sketch and write at least three ideas on the back of this page. Think about the following questions: How will the deck be raised above the ground? How will the treehouse stand on its own? How would people get into and out of the treehouse?

2. Think about which design might best meet each of the criteria. Draw a star by the design you will build. Why did you choose this idea?

3. Brainstorm some ideas here for the two (or more) extra, fun things you will include in your treehouse model.

4. On a piece of graph paper, draw a plan of your model, including all of the ideas to meet the criteria. Each square of graph paper should equal one inch on your model. Label all of the materials and measurements.

5. Build your treeless treehouse model according to your plan! Measure often as you are building to be sure you are following your plan in 1:12 scale.

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STEP 3: TEST, IMPROVE, AND SHARE

1. Check to see that your model meets each criteria:
   - ☐ The deck is raised above the ground.
   - ☐ The treehouse stands up by itself.
   - ☐ There is at least one way for people to get in and out.
   - ☐ The treehouse is protected from the elements.
   - ☐ Extra, fun idea #1: _____
   - ☐ Extra, fun idea #2: _____
   - ☐ The treehouse model is in 1:12 scale.
2. Does your treehouse model meet all the criteria? If not, how could you improve it?

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

4. Keep redesigning until your treehouse model meets the criteria!

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STEP 4: REFLECT

1. Answer these questions about how your design meets each criteria.
   - How do people get in and out of your treehouse?

     _____
   - How far is the deck raised above the ground in your model?

     _____
   - How far would the deck be above the ground in the full-sized treehouse?

     _____
   - Is your treehouse model in 1:12 scale? How do you know?

     _____

2. What other features did you include in your model?

   _____

   _____

3. How did you improve your design?

   _____

   _____

4. What was the hardest part about this challenge?

   _____

   _____

5. What have you learned from this challenge?

   _____

   _____