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Questions 1–16 (SG pp. 186–189)

1.* Drop height

2.* Bounce height

3.* Possible answers: the surface of the floor, the ball, the way the ball is dropped.

4. A. numerical
   B. numerical
   C. categorical

5.* See lesson

6. A. 0 cm
   B. Check that students included the point (0, 0) on their graphs.

7.* Answers will vary. The points form a line that goes uphill. See Figures 4 and 5 in lesson 4 for sample student graphs.

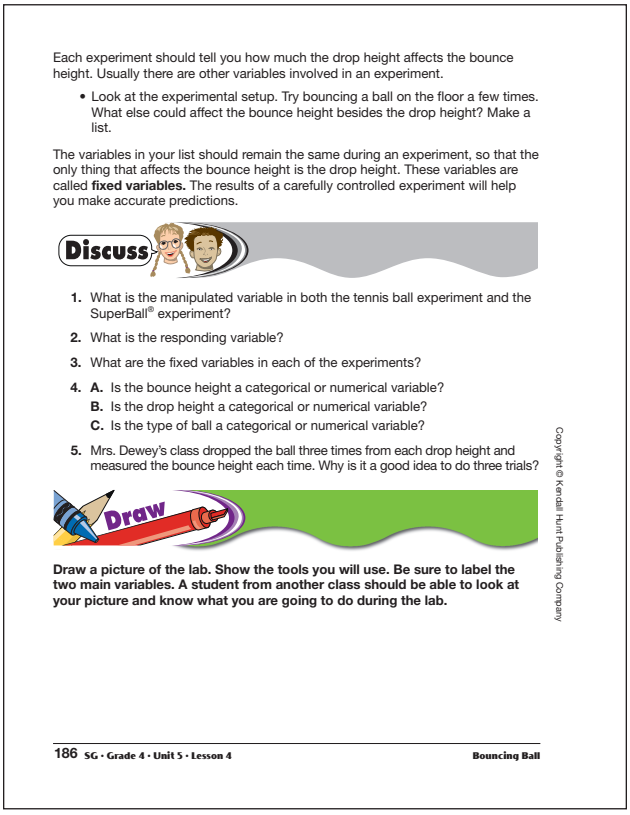
Answers to ***Questions 8–10*** are based on the sample graph in Figure 4 of lesson 4.

8. A.* Answers will vary. About 32 cm.
   B.* interpolation
   C.* Answers will vary.
   D.* Answers will vary. See Content Note, What's Close? in lesson 4.

9. A.* Answers will vary. About 142 cm.
   B.* extrapolation
   C.* Answers will vary.
   D.* Answers will vary. See Content Note, What's Close? in lesson 4.

10. A. Answers will vary. About 94–96 cm.
    B. Answers will vary. With drop height of 60 cm, ball bounces to about 32 cm. 180 cm is 3 times 60 cm. So the ball would bounce 3 times as high or about 96 cm. With drop height of 90 cm, ball bounces to about 47 cm. 180 cm is twice 90 cm. The ball would bounce twice as high—about 94 cm.
    C. Answers will vary.
    D. Answers will vary. See Content Note, What's Close? in lesson 4.

11.* See lesson.



Each experiment should tell you how much the drop height affects the bounce height. Usually there are other variables involved in an experiment.

- Look at the experimental setup. Try bouncing a ball on the floor a few times. What else could affect the bounce height besides the drop height? Make a list.

The variables in your list should remain the same during an experiment, so that the only thing that affects the bounce height is the drop height. These variables are called **fixed variables.** The results of a carefully controlled experiment will help you make accurate predictions.

Discuss

1. What is the manipulated variable in both the tennis ball experiment and the SuperBall® experiment?
2. What is the responding variable?
3. What are the fixed variables in each of the experiments?
4. **A.** Is the bounce height a categorical or numerical variable?
   B. Is the drop height a categorical or numerical variable?
   C. Is the type of ball a categorical or numerical variable?
5. Mrs. Dewey's class dropped the ball three times from each drop height and measured the bounce height each time. Why is it a good idea to do three trials?

Draw

Draw a picture of the lab. Show the tools you will use. Be sure to label the two main variables. A student from another class should be able to look at your picture and know what you are going to do during the lab.

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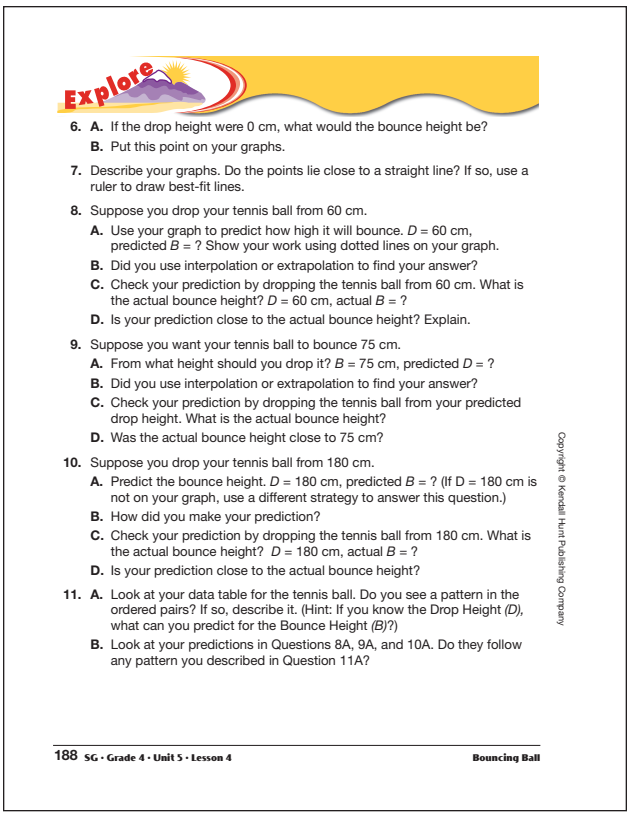

Explore

6. **A.** If the drop height were 0 cm, what would the bounce height be?
   B. Put this point on your graphs.
7. Describe your graphs. Do the points lie close to a straight line? If so, use a ruler to draw best-fit lines.
8. Suppose you drop your tennis ball from 60 cm.
   A. Use your graph to predict how high it will bounce. D = 60 cm, predicted B = ? Show your work using dotted lines on your graph.
   B. Did you use interpolation or extrapolation to find your answer?
   C. Check your prediction by dropping the tennis ball from 60 cm. What is the actual bounce height? D = 60 cm, actual B = ?
   D. Is your prediction close to the actual bounce height? Explain.
9. Suppose you want your tennis ball to bounce 75 cm.
   A. From what height should you drop it? B = 75 cm, predicted D = ?
   B. Did you use interpolation or extrapolation to find your answer?
   C. Check your prediction by dropping the tennis ball from your predicted drop height. What is the actual bounce height?
   D. Was the actual bounce height close to 75 cm?
10. Suppose you drop your tennis ball from 180 cm.
    A. Predict the bounce height. D = 180 cm, predicted B = ? (If D = 180 cm is not on your graph, use a different strategy to answer this question.)
    B. How did you make your prediction?
    C. Check your prediction by dropping the tennis ball from 180 cm. What is the actual bounce height? D = 180 cm, actual B = ?
    D. Is your prediction close to the actual bounce height?
11. **A.** Look at your data table for the tennis ball. Do you see a pattern in the ordered pairs? If so, describe it. (Hint: If you know the Drop Height *(D)*, what can you predict for the Bounce Height *(B)*?)
    B. Look at your predictions in Questions 8A, 9A, and 10A. Do they follow any pattern you described in Question 11A?

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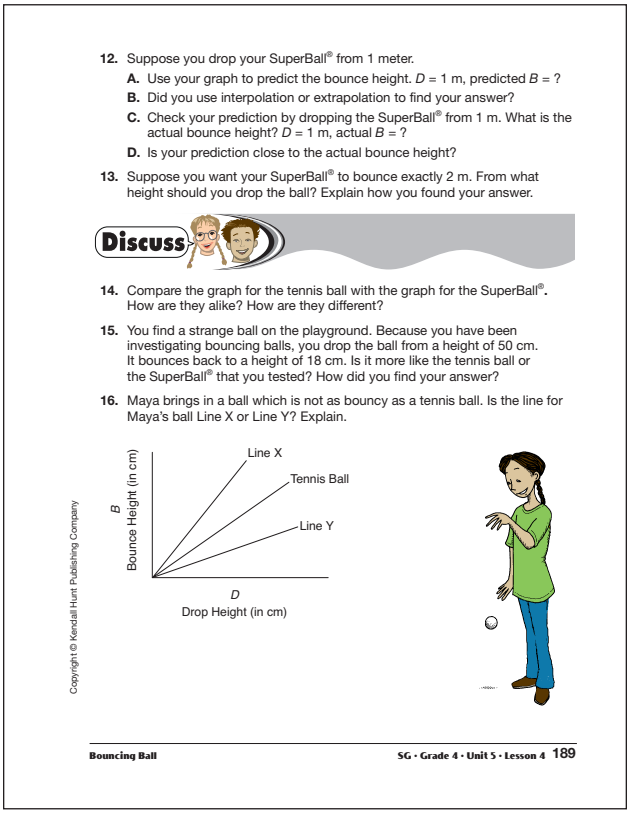
***Answers and/or discussion are included in the lesson.**



12. Suppose you drop your SuperBall® from 1 meter.
    - **A.** Use your graph to predict the bounce height. D = 1 m, predicted B = ?
    - **B.** Did you use interpolation or extrapolation to find your answer?
    - **C.** Check your prediction by dropping the SuperBall® from 1 m. What is the actual bounce height? D = 1 m, actual B = ?
    - **D.** Is your prediction close to the actual bounce height?
13. Suppose you want your SuperBall® to bounce exactly 2 m. From what height should you drop the ball? Explain how you found your answer.

Discuss

14. Compare the graph for the tennis ball with the graph for the SuperBall®. How are they alike? How are they different?
15. You find a strange ball on the playground. Because you have been investigating bouncing balls, you drop the ball from a height of 50 cm. It bounces back to a height of 18 cm. Is it more like the tennis ball or the SuperBall® that you tested? How did you find your answer?
16. Maya brings in a ball which is not as bouncy as a tennis ball. Is the line for Maya's ball Line X or Line Y? Explain.

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Answers to ***Questions 12*** and ***13*** are based on the graph in Figure 5 of lesson 4.

12. A. Answers will vary. About 76 cm.

B. interpolation

C. Answers will vary.

D. Answers will vary. See Content Note, What's Close? in lesson 4.

13.* Answers will vary. About 260 cm.

14.* Answers will vary. Both graphs are lines that go uphill. The line for the SuperBall® is steeper than the line for the tennis ball. For any given drop height, the bounce height is greater for the SuperBall® than for the tennis ball.

15.* Tennis ball

16.* Line Y

***Answers and/or discussion are included in the lesson.**

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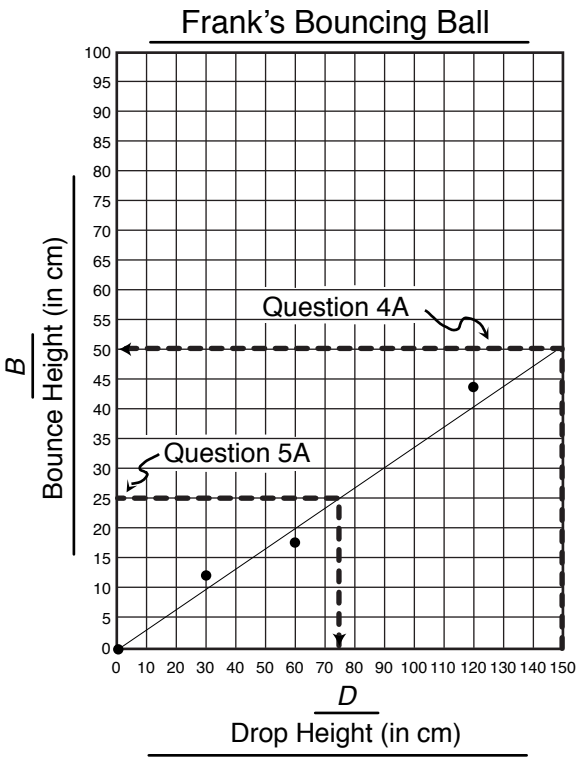
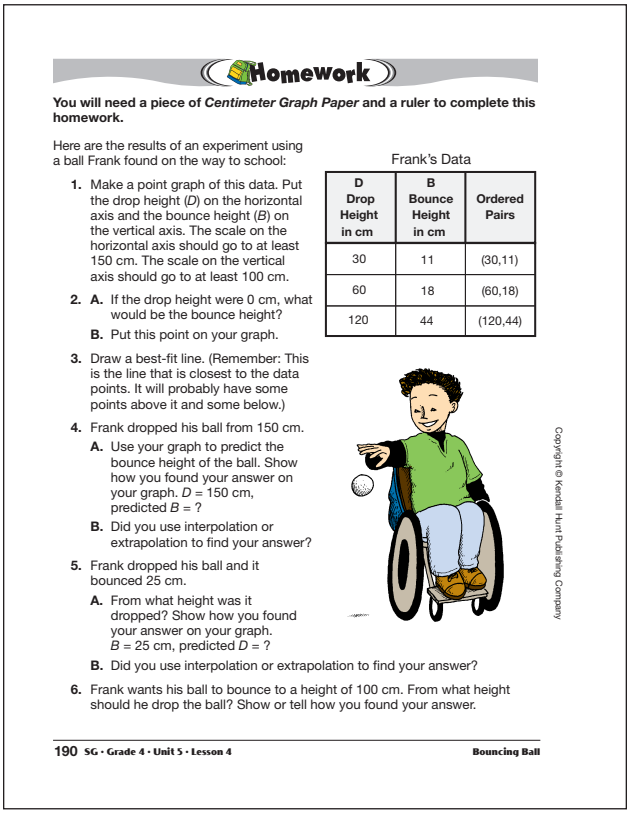
Homework

Questions 1–6 (SG p. 190)

1.



2. **A.** 0 cm
   B. Check that students' graphs include the point (0, 0).
3. See the graph in ***Question 1.***
4. **A.** About 50 cm; See the graph in ***Question 1.***
   B. extrapolation
5. **A.** About 75 cm; See the graph in ***Question 1.***
   B. interpolation
6. 300 cm; Solution strategies will vary. In ***Question 4A*** we found that Frank's ball will bounce to about 50 cm when dropped from 150 cm. If we want the bounce height to double from 50 cm to 100 cm, we should double the drop height from 150 cm to 300 cm.



Homework

You will need a piece of *Centimeter Graph Paper* and a ruler to complete this homework.

Here are the results of an experiment using a ball Frank found on the way to school:

Frank's Data

D Drop Height in cm	B Bounce Height in cm	Ordered Pairs
30	11	(30,11)
60	18	(60,18)
120	44	(120,44)

1. Make a point graph of this data. Put the drop height (*D*) on the horizontal axis and the bounce height (*B*) on the vertical axis. The scale on the horizontal axis should go to at least 150 cm. The scale on the vertical axis should go to at least 100 cm.
2. **A.** If the drop height were 0 cm, what would be the bounce height?
   B. Put this point on your graph.
3. Draw a best-fit line. (Remember: This is the line that is closest to the data points. It will probably have some points above it and some below.)
4. Frank dropped his ball from 150 cm.
   A. Use your graph to predict the bounce height of the ball. Show how you found your answer on your graph. *D* = 150 cm, predicted *B* = ?
   B. Did you use interpolation or extrapolation to find your answer?
5. Frank dropped his ball and it bounced 25 cm.
   A. From what height was it dropped? Show how you found your answer on your graph. *B* = 25 cm, predicted *D* = ?
   B. Did you use interpolation or extrapolation to find your answer?
6. Frank wants his ball to bounce to a height of 100 cm. From what height should he drop the ball? Show or tell how you found your answer.

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