# Escape From the Tomb

NAME _____

In the action-adventure game *Escape from the Tomb*, players encounter a variety of obstacles. The final stage of the game is to escape through a secret passageway—if you can figure out how to open the door.

Bart and Lisa have been playing this game for a while, but they can't figure out how to escape. They need your help!

In front of the secret passage, there is a basket hanging on either side of the door. Next to one basket is a pile of silver coins, and next to the other basket is a pile of gold coins. (One thing to note—gold coins are heavier than silver coins.) The basket next to the silver coins is lower than the basket next to the gold coins. To open the door in front of the passageway, you must make both baskets hang to the same level. But there's a catch—you must place the same number of coins in each basket.

Can you figure out how many coins are needed? Good luck!

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## Setting Up the Experiment

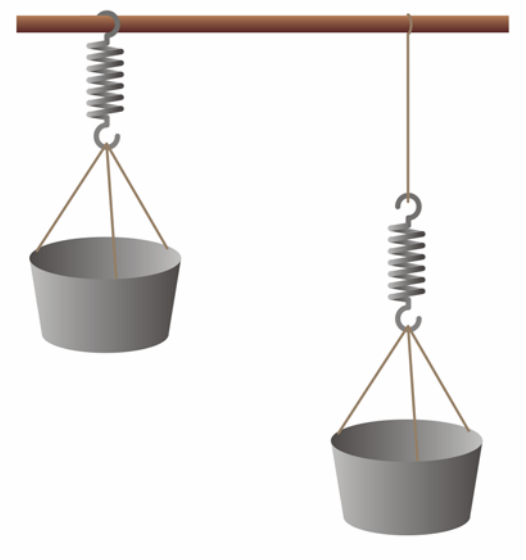
To complete this activity, your group will need the following materials:

- Two springs
- Two small bowls (paper or plastic)
- Bag of bingo chips
- Bag of marbles
- String, scissors
- Tape measure
- Calculator

To create the baskets, do the following:

1. Punch three holes, equally spaced, around the lip of a bowl.
2. Thread a piece of string (approximately 5 inches long) through each hole.
3. Tie all six ends of the string together in a knot above the bowl.
4. Slide the hook of the spring underneath the knot in the string.
5. Attach the other end of the spring to something hanging from the ceiling. (If you need help with this part, ask your teacher.)
6. Repeat Steps 1-5 for the second bowl. Then, tie a piece of string to the spring, and attach the other end of the string to something hanging from the ceiling. The second bowl should hang lower than the first bowl.

Your final arrangement should look like this:



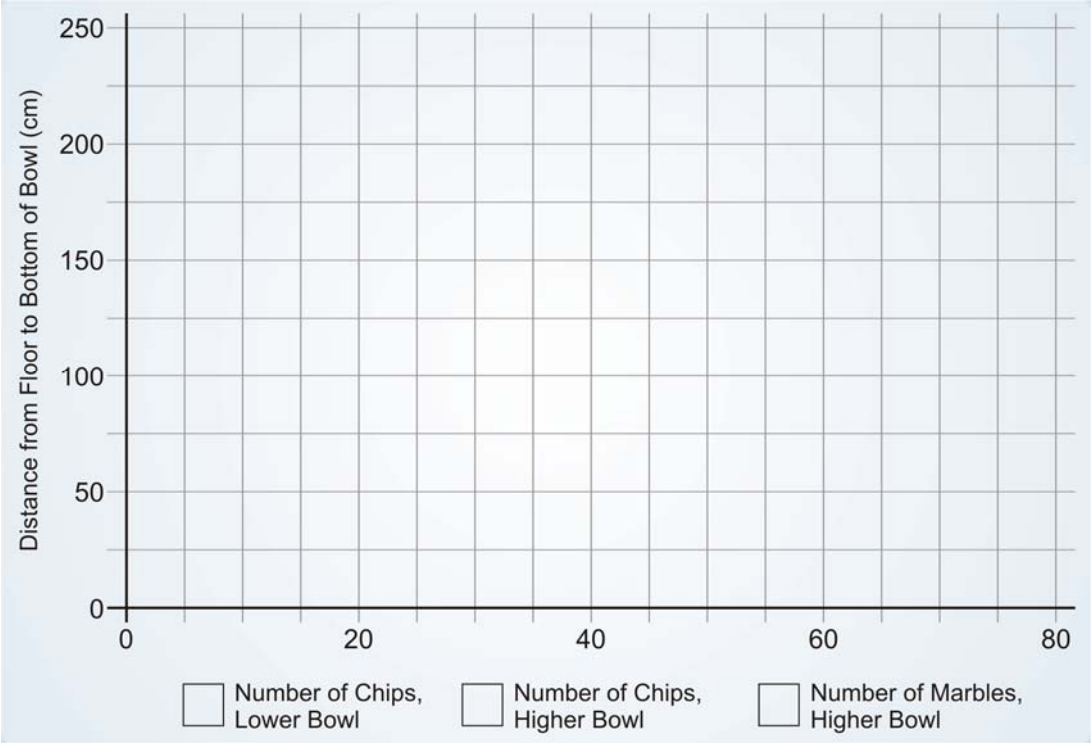
## Experiment 1

**1.** Measure the distance from the floor to the bottom of the **lower bowl**, in *centimeters*. Record this value in the table below (for 0 bingo chips).

Then, add 5, 10, 15, …, bingo chips to the bowl. Each time you add more chips, measure the distance to the bottom of the bowl and record the result in the table. Continue until you have at least eight data points.

| Number of Bingo Chips | 0 | 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Distance from the Floor to the Bottom of the Lower Bowl | | | | | | | | |

**2.** Display your data on the grid below. In the legend below the grid, indicate the color you use to represent this data. (That is, color the box for "Number of Chips, Lower Bowl.")




Note: You will use this graph again for Questions 9 and 15.

**3.** Each time you add a bingo chip to the bowl, the distance between the floor and the bowl decreases. Discuss with your team how to find the average displacement per bingo chip.

Using one of the strategies that you discuss, find the average displacement. Show how you arrived at your answer.

How is this value reflected in your graph?

**4.** Using the information from your table, your graph, and your calculation of the average displacement per bingo chip, write an equation relating the distance from the floor to the bowl ($y$) in terms of the number of chips in the bowl ($x$).

**5.** Remove all chips from the bowl. Then, **without counting**, grab a handful of chips and place them gently in the lower bowl.

Measure the distance from the floor to the bottom of the bowl: _____ centimeters.

**a.** Using the information above, *algebraically* determine the number of bingo chips in the bowl. Show your work.

**b.** Count the number of Bingo chips in the bowl. How close was your prediction to the actual number of bingo chips?

**c.** Suppose there were 28 bingo chips in the bowl, but you did not have a tape measure to determine the distance. How could you calculate the distance from the floor to the bottom of the bowl? What would the distance be? Show or explain how you arrived at your answer.

## Experiment 2

**6.** Remove the bingo chips from the lower bowl. Using the **higher bowl**, repeat the experiment. Use the same number of bingo chips for each trial as you used in the Experiment 1. Record your data in the table below.

| NUMBER OF BINGO CHIPS | 0 | 5 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DISTANCE FROM THE FLOOR TO THE BOTTOM OF THE LOWER BOWL | | | | | | | | |

**7.** How is this data different from your data in Experiment 1?

**8.** For Experiment 2, what is the average displacement per bingo chip?

How does this value compare to the value for the average displacement in Experiment 1? Does this make sense? Explain.

**9.** Using a different color, plot the data from the second experiment on the grid in Question 2. Indicate this color in the legend under the grid.

**10.** Using the information from your table, your graph, and your calculation of the average displacement per bingo chip, write an equation relating the distance from the floor to the bowl ($y$) in terms of the number of chips in the bowl ($x$).

**11.** Note any similarities and differences between your equations for Experiment 1 and Experiment 2.

**a.** How are they alike?

**b.** How are they different?

**c.** If this bowl were raised 5 cm, how would the equation change? What would the new equation be?

**12.** What do you notice about the graphs of the two lines? How is this relationship reflected in their equations?

## Experiment 3

**13.** Remove the bingo chips from the bowl.Repeat the experiment using marbles instead of bingo chips in the **higher bowl**. Record your data in the table below.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NUMBER OF BINGO CHIPS | 0 | 5 | | | | | | |
| DISTANCE FROM THE FLOOR TO THE BOTTOM OF THE LOWER BOWL | | | | | | | | |

**14.** For Experiment 3, what is the average displacement per bingo chip?

How does this value compare to the value for the average displacement per bingo chip? Does this make sense? Explain.

**15.** Using a different color, plot the data from the second experiment on the grid in Question 2. Indicate this color in the legend under the grid.

**16.** Using the information from your table, your graph, and your calculation of the average displacement per marble, write an equation relating the distance from the floor to the bowl ($y$) in terms of the number of chips in the bowl ($x$).

**17.** What do you notice about the graphs of the two lines? How is this relationship reflected in their equations?

**18.** Refer to the graphs for **Experiment 1** and **Experiment 3**.

**a.** When ten items are placed in each bowl, what is the distance from the floor to the bottom of the bowl?

**Experiment 1**: _____ cm **Experiment 3**: _____ cm

**b.** When the bowls are 100 cm from the floor, how many items were placed in each bowl?

**Experiment 1**: _____ chips **Experiment 3**: _____ marbles

**c.** At what point is the distance from the floor and the number of items the same for each bowl?

**Height**: _____ cm **Number of Items**: _____

**d.** How did you arrive at this information from your graphs?

**19.** Test your results using the two bowls. Place the number of bingo chips stated in your answer to the previous question in the **lower bowl**. Place the same number of marbles in the **higher bowl**. Are the bowls the same distance from the floor? If not, explain why not.

**20.** Solve this problem *algebraically* using your equations from Questions 10 and 16.

## Solving the Game

Now it is time to *Escape from the Tomb* and figure out how to open the door in front of the secret passageway!

Lisa and Bart know that one of the baskets is 50 centimeters lower than the other. Explain to Lisa and Bart the fastest way to determine the number of coins that must be placed in each basket so that the heights of the two baskets are the same. (Speed is important here—Bart and Lisa only have a minute left to solve the puzzle!)