Poster and Teaching Guide
Grades 3–5

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# BAT-MATH

## Build measurement and engineering skills while fostering teamwork.

**CALCULATE AREA WITH BATMAN & ROBIN!**

**HELP BATGIRL FIGURE OUT THE JOKER'S ANGLE**



Visit **scholastic.com/bat-math**
to download a digital version of this program.

**BONUS**
**BAT-BRIDGE ENGINEERING CHALLENGE**

**+**
**BALLOON-POWERED BATMOBILE FAMILY ACTIVITY**




FEBRUARY
2017

ACTIVITY INSTRUCTIONS

**PROPEL LEARNING THROUGH TEAMWORK** Discuss the teamwork tips on the poster inside. Students can complete the worksheets in pairs to practice supporting and learning from each other.


### Lesson 1: Super-Hero Math

**Tiered For: Grade 3** (or additional review/support for Grades 4–5)

**Materials:** Student Worksheet 1

**Objective:** Students will learn that area is the space inside a shape, that area can be determined by tiling or multiplication, and that the proper unit of measure for area is square units.

**1.** Tell the class that Batman has decided to construct an engineering workshop in the Batcave in order to invent new gadgets for protecting the city. Since engineering can get messy, Robin offered to help him lay down durable protective tiles on a section of the floor. Each tile is 1 foot square, and they plan to cover an area that is 5 feet long and 6 feet wide. How many tiles will they need?

**2.** Draw a 5' x 6' array on the board. Show that the number of tiles can be found by counting the number of squares. Show how the number of tiles can also be found by multiplying the array's length by its width.

**3.** Indicate that area is the space inside a shape and can be determined either by counting the number of square units or by multiplying the side lengths.

**4.** Explain that the proper unit of measure for area is square units (in this case, square feet, also written as $ft^2$), as opposed to units, which we use to measure side length, perimeter, etc.

**5.** Distribute Student Worksheet 1.

**6.** Review answers as a class.

**Extension:** Have students design a rectangular area for a pet and calculate the area.

**Worksheet 1 Answer Key**

**1)** 72 square feet; **2)** 270 square feet, Yes;
**3)** Answers could include:
L = 4 feet, W = 25 feet, Perimeter = 58 feet
L = 25 feet, W = 4 feet, Perimeter = 58 feet
L = 10 feet, W = 10 feet, Perimeter = 40 feet
**4)** Answers will vary

### Lesson 2: The Joker's Lair Is Acute Place!

**Tiered For: Grade 4** (or additional review or challenge for other grades)

**Materials:** Student Worksheet 2

**Objective:** Students build on their basic knowledge of protractors to solve a real-world problem.

**1.** Review angle definitions:

- **Acute**: Less than 90° • **Right**: Exactly 90°
- **Obtuse**: Greater than 90° and less than 180°

**2.** Distribute Student Worksheet 2.

**3.** Determine the first step of Batman's plan as a class.

**4.** Direct the class to first look at the diagram, notice where the entrance is, and determine the type of angle formed by the path from the entrance to the Card Dispenser (acute, since Batman is looking straight ahead when he enters the lair).

**5.** Direct the class to place the hole of the protractor over the "X" at the entrance and line up the bottom of the protractor with the horizontal line formed by the entrance.

**6.** Measure the angle length of the ray formed by the path to the first stop. The ray goes through the 45/135 point on the protractor. Because this is an acute angle, 45 degrees right is the amount of the turn. Because the scale is 1"=2', the distance is 4 feet.

**7.** Ask the class to complete the plan individually, then review answers as a group.

**Extension:** Have students conduct a life-size treasure hunt out on the school blacktop using protractors, masking tape, and yardsticks. Each student (or group of students) picks a location to "bury" their treasure, then writes directions for others to follow by noting the angle measurement of turns and the length of each leg of the journey.

**Worksheet 2 Answer Key**

**1)** 45°, 4 feet; **2)** 45°, 4 feet; **3)** 90°, 6 feet;
**4)** 120°, 6 feet; **5)** 120°, 4 feet

### Lesson 3: Saving the City With Math!

**Tiered For: Grade 5** (or additional challenge for Grades 3–4)

**Materials:** Student Worksheet 3

**Objective:** Students learn to identify the $(x, y)$ coordinates of points on a coordinate grid, then use the coordinates to determine distances between points.

**1.** Before beginning the worksheet, project or draw a new coordinate grid on the board.

**2.** Draw point A and point B at (4, 2) and (4, 5), respectively. Ask students to identify the coordinates. If necessary, review the $(x, y)$ grid system.

**3.** Ask students to find the distance from point A to point B. Point out that the $x$ coordinate is the same, so the distance equals the difference between the $y$ coordinates ($5 - 2 = 3$ units). It is possible to find the distance by counting the grid marks between the two points, but subtracting the $y$ coordinates will be preferable in most calculations.

**4.** Distribute Student Worksheet 3.

**5.** Review answers as a class.

**Extension:** Ask students to use grid paper to make a scale drawing of a place of their choice (classroom, bedroom at home, etc.). Students should label the coordinates of important features in their drawing.

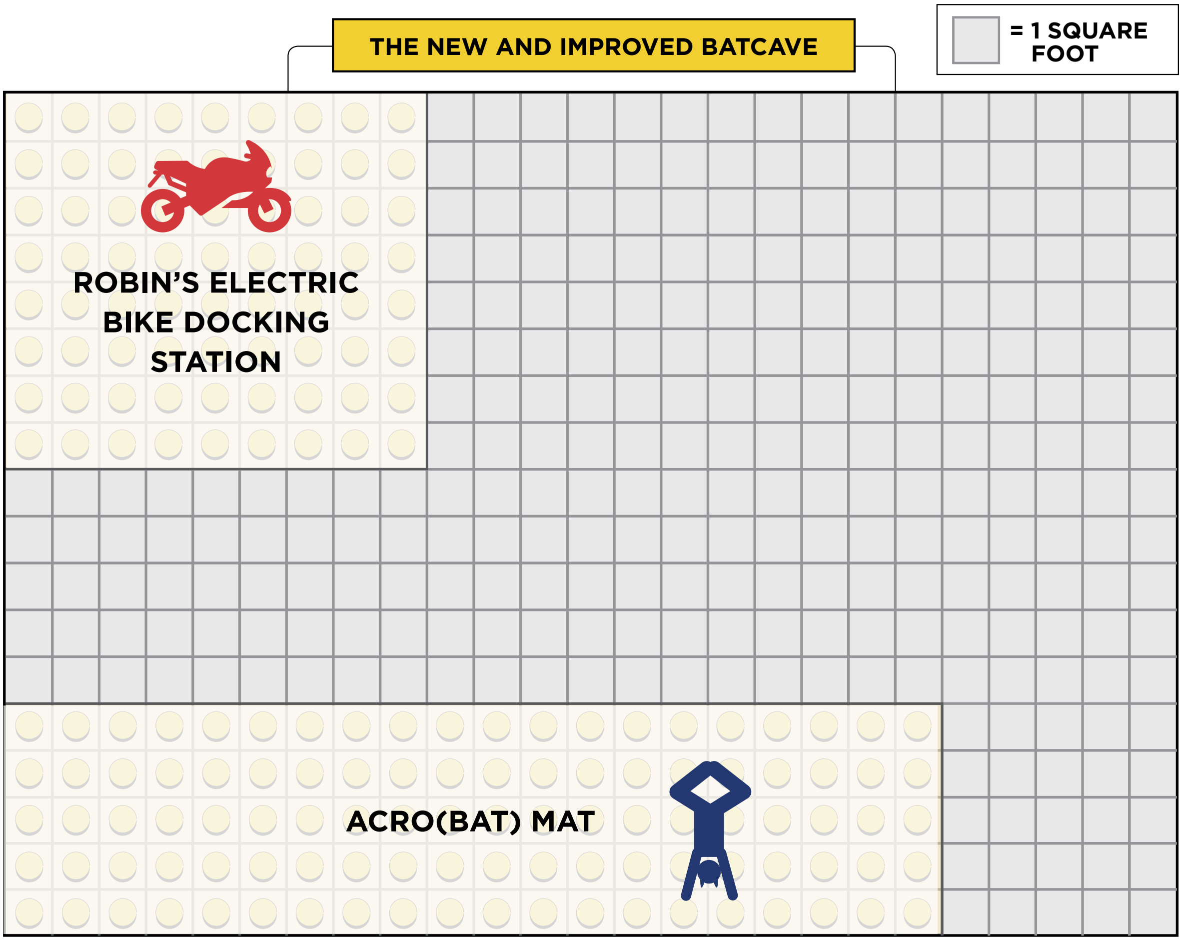
**Worksheet 3 Answer Key**

**Part 1: Batcave** (1, 1); **A** (1, 4); **B** (6, 4); **C** (6, 5); **D** (10, 5); **E** (10, 9); **The Joker's Lair** (14, 9)

**Part 2: Batcave to A:** .6 mile north; **A to B:** 1 mile east; **B to C:** .2 mile north; **C to D:** .8 mile east; **D to E:** .8 mile north; **E to The Joker's Lair** .8 mile east

# SUPER-HERO MATH

**In between protecting the city from crime, Batman and Robin relax by redecorating the Batcave. They each tried several designs that didn't work out. Now they've decided to pool their ideas and work together to make the Batcave the most awesome super-hero lair anywhere!**




**DIRECTIONS: Use the grid and your knowledge of area and perimeter to answer the following questions.**

1. Batman and Robin have turned their old garage into a docking station for Robin's electric bike. What is the area of Robin's Electric Bike Docking Station? ________________

2. To make room for more Batmobile vehicles, Batman and Robin plan to build a bigger garage in a section of the Batcave that is 300 square feet. They designed a garage that is 30 feet by 9 feet.

   What is the area of the new garage? ______________

   Will the new garage fit in the available space? _______

3. Draw in an Acro(Bat) mat with the same area but with a different length and width. What is the length, width, and perimeter of your redesigned mat?

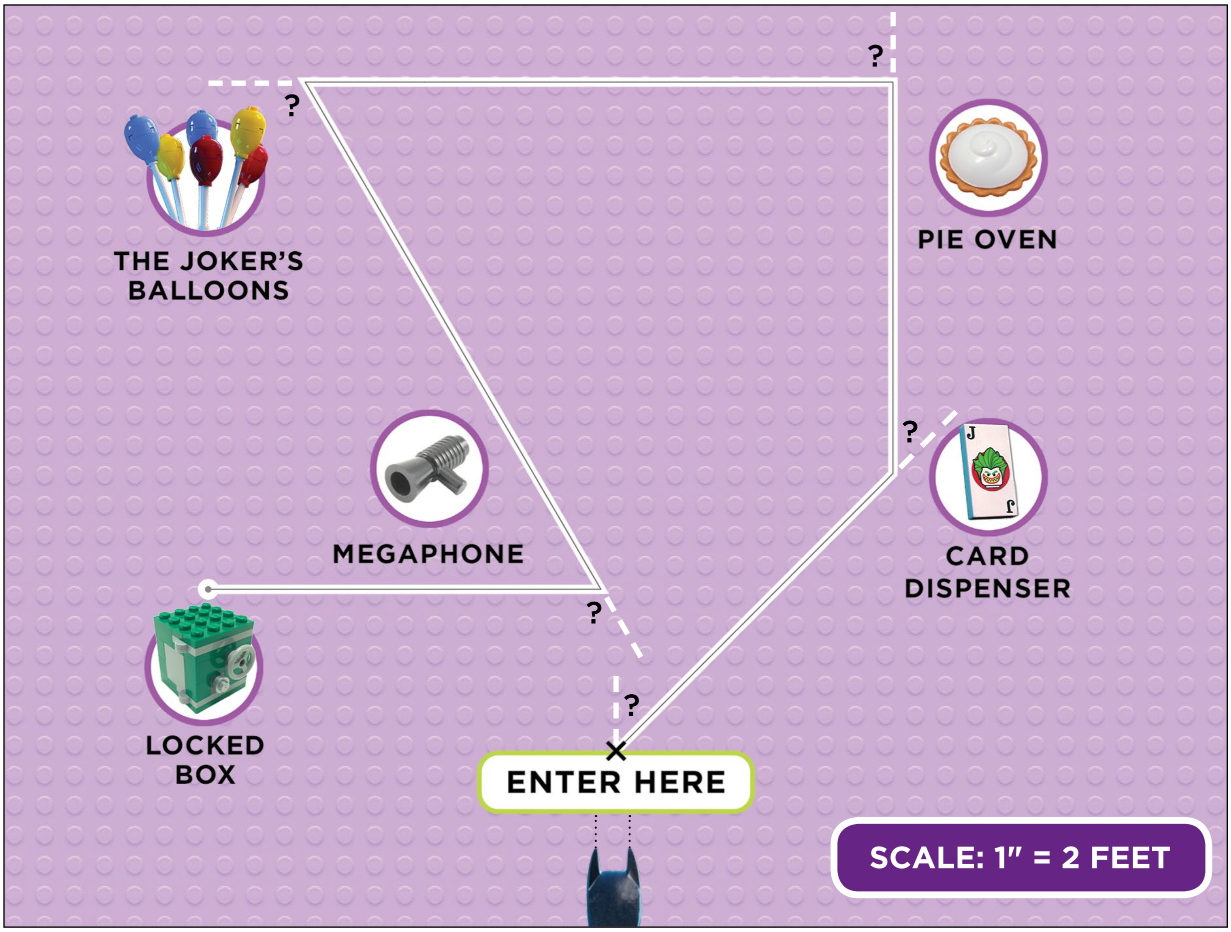
   Length: _______ Width: _______ Perimeter: _______

4. Batman and Robin have teamed up to engineer a new and improved Batmobile for their upcoming mission. Draw in a rectangular workshop where they can work on their invention. Then label the length and width, and calculate the area and perimeter.

   Area: ___________ Perimeter: ___________

# THE JOKER'S LAIR IS ACUTE PLACE!

Batman has intercepted a message revealing the location of a box where The Joker has hidden his secret code! Batman will have to follow a precise route in the dark to find it without bumping into anything. With the help of Robin and Batgirl, Batman will figure out the angles and distance he has to walk.

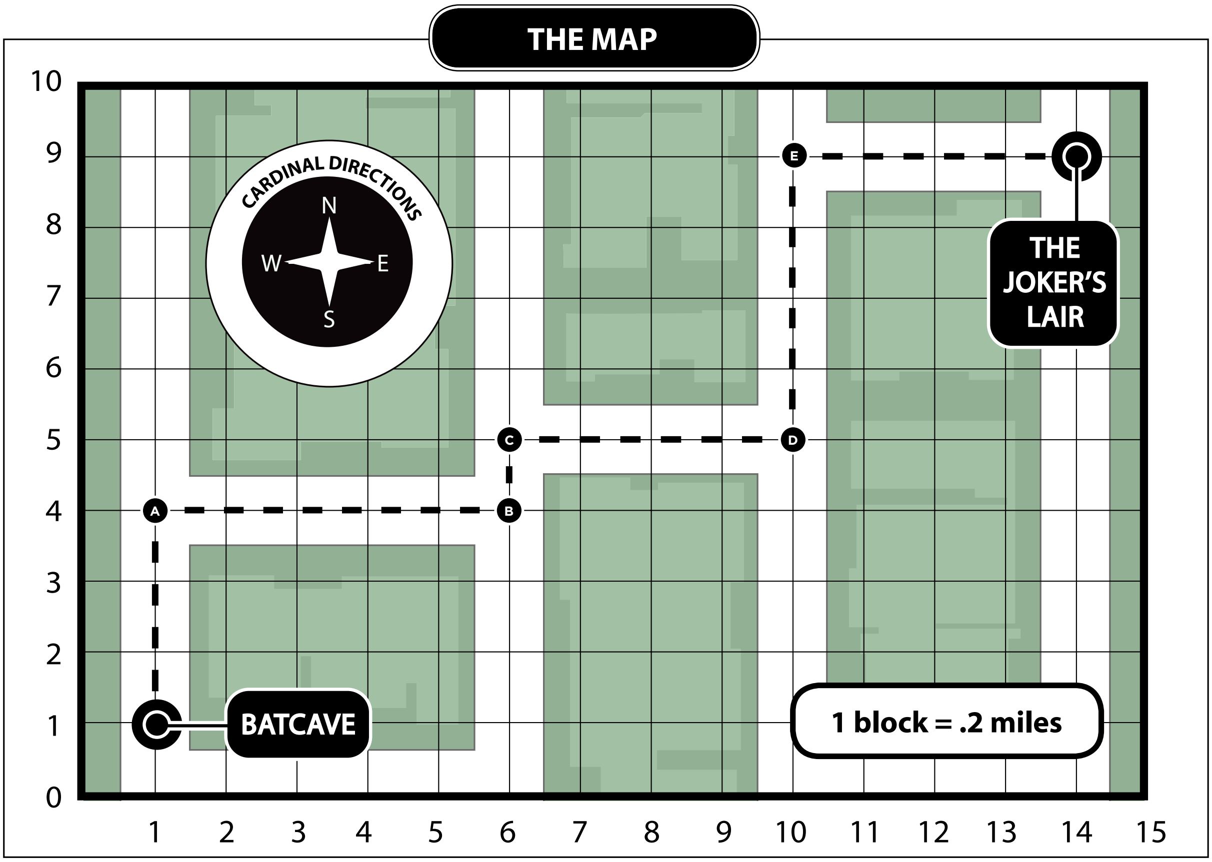



**DIRECTIONS:** **Use a protractor and a ruler to measure the angles and distances to help Batman.**

1. Enter the lair, turn __________ degrees right, and walk forward __________ feet to the Card Dispenser.
2. Turn __________ degrees left and walk forward __________ feet to the Pie Oven.
3. Turn __________ degrees left and walk forward __________ feet to The Joker's Balloons.
4. Turn __________ degrees left and walk forward __________ feet to the Megaphone.
5. Turn __________ degrees right and walk forward __________ feet to the Locked Box!
6. Break the lock on the box to reveal the secret code! **YOU SAVED THE CITY!**

# SAVING THE CITY WITH MATH!

The Joker has planned his most horrible trick yet! "Batman will never foil my plan," thought The Joker, "even if I give him a map leading him to my lair." Batman received the map, but he needs Robin and Batgirl's help to decipher it and to program the Batmobile's on-board navigation system.




**DIRECTIONS:** **Part 1** To program the Batmobile navigation system, first find the (*x*, *y*) coordinates of each turning point on the route:

Batcave______ A______ B______ C______ D______ E______ The Joker's Lair_______

**Part 2** Then give the directions from the Batcave to the navigation system using the compass on the map.

| | DISTANCE IN MILES | CARDINAL DIRECTION |
|---|---|---|
| Batcave to Point A | | |
| Point A to B | | |
| Point B to C | | |
| Point C to D | | |
| Point D to E | | |
| E to The Joker's Lair | | |

# ENGINEERING CHALLENGE

## DIRECTIONS

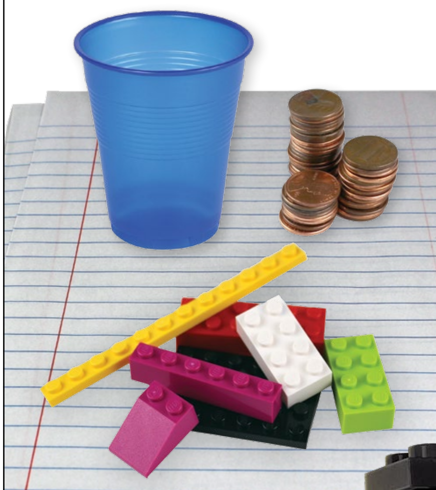
**The Joker has wreaked havoc on Gotham City's bridge. Now it's up to Batman and Robin and some super friends to save the day! They've teamed up to rebuild the bridge...except they have no idea how to build a bridge! But that won't stop them. Batman and Robin plan to work together, sharing their ideas and learning from their mistakes until they get it right.**

## DIRECTIONS

1. Using LEGO® bricks, wood, or other materials, build two support towers for your bridge. Each support tower should measure 2″ x 4″ x 6″.
2. Place the two support towers about 5″ apart.
3. Begin Engineering Trial 1 by arranging the piece of paper so that it rests on the towers. You may manipulate the paper any way you see fit, but you may not add any materials, such as tape, glue, clips, etc.
4. Place the cup on the paper and add pennies until the bridge collapses.
5. Record the number of pennies the bridge held before it collapsed and complete the **Engineering Trial 1** section of the Engineering Challenge Recording Sheet.
6. Refine your design for Engineering Trial 2 and retest to see how many pennies the new design can hold. Complete the **Engineering Trial 2** section of the Engineering Challenge Recording Sheet.

## MATERIALS PER GROUP

- **LEGO® bricks, wood, or other available materials**
- **One sheet of 8.5″ x 11″ paper**
- **50–100 pennies**
- **Small paper or plastic cup**



## TEAMWORK TIPS

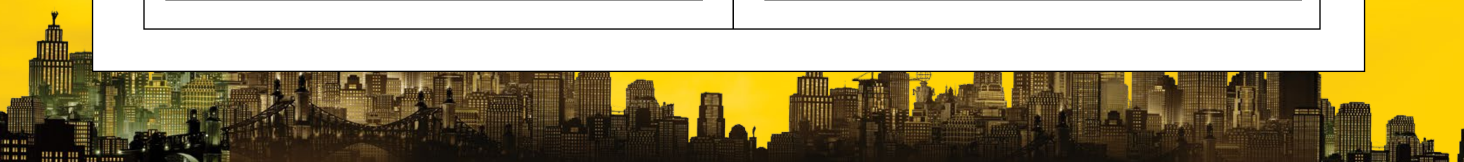
**LISTEN • EXPLAIN • ASK • SUPPORT**

# ENGINEERING CHALLENGE

## RECORDING SHEET

As you build your bridge, use this sheet to record the results of your engineering trials. Remember to listen and share ideas with your teammates to help build a stronger bridge. Sometimes it takes a few tries to solve a problem—don't give up!

| ENGINEERING TRIAL 1 | ENGINEERING TRIAL 2 |
|---|---|
| Number of Pennies Held: ____________ | Number of Pennies Held: ____________ |
| Describe how you designed your first bridge: | Describe how you improved your bridge: |
| | |



FAMILY ENGINEERING ACTIVITY

# TEAM UP TO BUILD A BALLOON-POWERED CAR

Download a template to build a car like this one at: **scholastic.com/bat-math/template**

In class, we've been exploring math and engineering concepts. We've learned that sometimes it takes a few tries to engineer an invention, and that's OK—we keep trying! We've also found that teamwork is a great way to learn, so let's build something together!

## DIRECTIONS

1. Trace a rectangle or similar shape and four circles on the cardboard or foam trays using the following dimensions: 7″ x 3″ rectangle; 1.5 to 1.75″ circles (four total). Optional: Decorate with markers or other materials.
2. Blow up the balloon, then let the air out to make it easier to blow up later.
3. Tape the opening of the balloon around the short end of the flexible straw so that no air can escape. Cut a ¼″ hole in the rear of the car and insert the long end of the straw into the hole. Pull through until the flexible area of the straw is in the hole.
4. Tape the long end of the straw to the bottom of the car with the open tip hanging off the back.
5. Push the pins through the center of the wheels and then into the edges of the body of the car. Leave a tiny bit of space between so the wheels can rotate.
6. Blow up the balloon through the straw and then pinch the end of the straw closed.
7. Place your Balloon-Powered Car on the floor and watch it go! Measure the distance the vehicle traveled by marking where it started and ended.
8. **Keep Moving Forward!** Figure out a way to add a seat in the car for each member of your family. Try a few different types of household materials. Which materials work well? Which materials slow the car down? Why might this be?

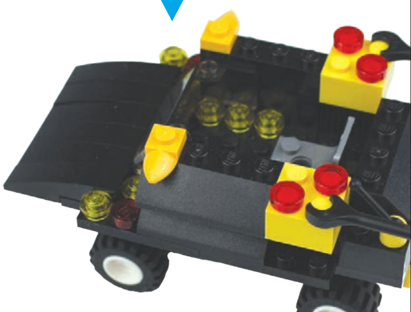
## MATERIALS

Find the tools below in your trusty Batcave (or at a store nearby):

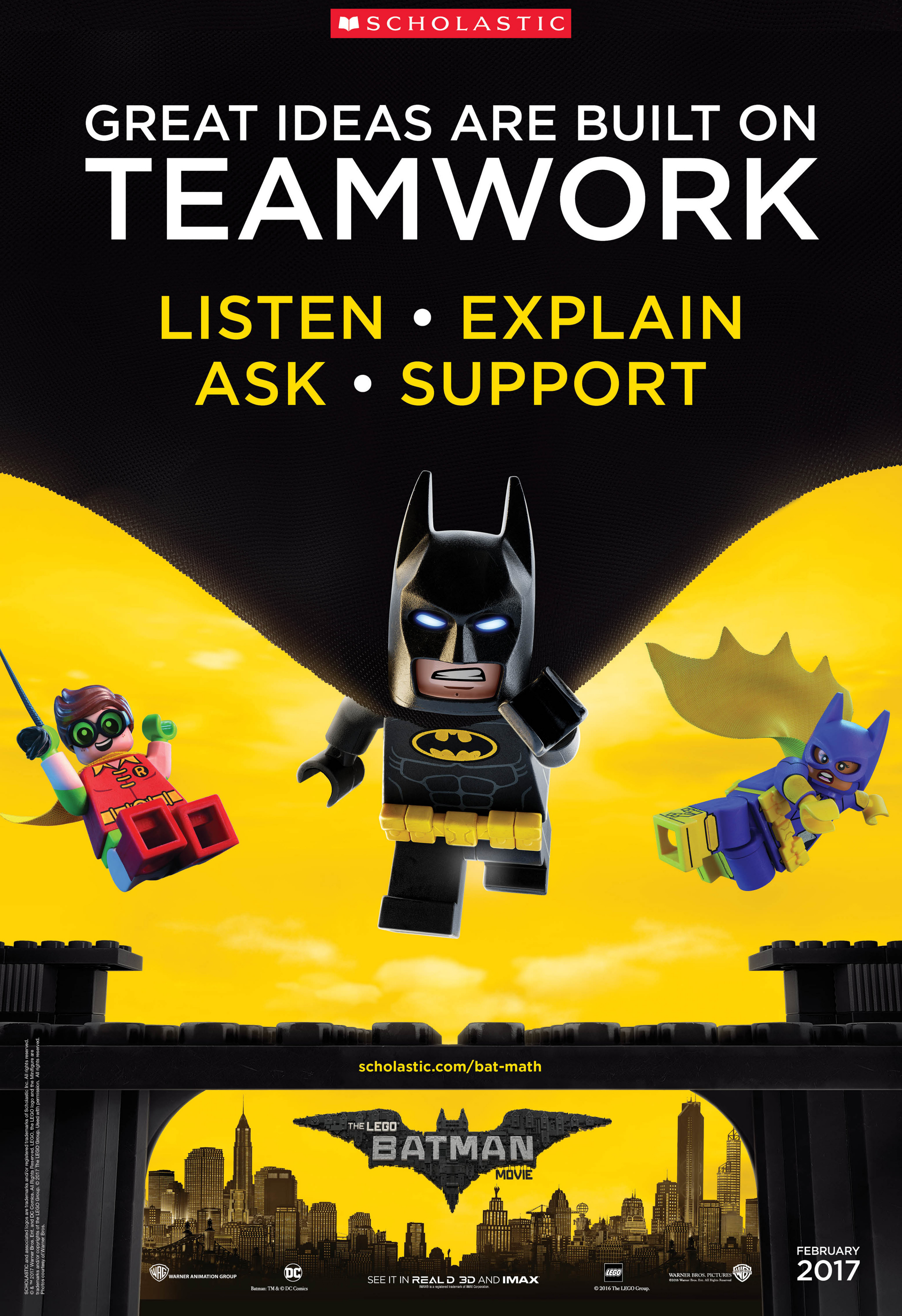
- Markers and ruler
- Scissors and tape
- 1–2 sheets of cardboard or foam trays
- Balloon (any size, but the bigger it is, the farther the car will travel)
- Flexible straw (any size)
- Straight pins (about 1 ¼″ long)

### BRICK CHALLENGE

Use LEGO® bricks or other building materials to construct an even sturdier balloon car!



**THE SUPER-HERO SCIENCE AT WORK:** When air exits the balloon in one direction, it forces the car to move in the opposite direction. You're seeing Newton's Third Law of Motion: Every action (in this case, when the air escapes the straw) has an equal and opposite reaction (your Batmobile moves in the other direction). This is the same principle that allows The Joker to make his air-powered escape in the movie.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