

Name \_\_\_\_\_ Date \_\_\_\_\_

## How Do Parachutes Work?

### Worksheet

1. Let's begin with some background information about the word parachute. It's a French word: "para" (protection against) + "chute" (fall). If you are planning to jump out of a plane, you definitely want some protection against free-falling.
2. "Free fall" is a way of simplifying what happens when things are dropped. If we pretend that we live in a vacuum (gasp!), then we don't need to worry about air resistance. In a vacuum, the only force acting on a falling object is gravity, and it applies an equal force to everything, no matter the mass or what shape it has. A leaf falls as fast as a hammer in a vacuum. How is this different from what naturally happens on Earth?
3. Since we don't live in a vacuum (whew!), air resistance happens. For example, you experience air resistance every time you ride your bike. The still air you "run into" resists moving out of your way. You need to push your way through it. A similar thing happens when a parachute falls through the air: It needs to push all the still air out of its way. A parachute falls slowly because it has such a large area—it needs to move a lot of air out of its way to continue falling. Consider the parachutes in this scene. One is small and the other is large. Both are supporting one person. Which one is likely to fall faster?
4. Let's do another "thought experiment." Imagine you have two identical parachutes. One has a very heavy object attached to it. The other has a very light payload. As they fall, the payloads "pull down" on the parachutes. The parachute with the heavy payload will hit the ground sooner than the other parachute. Why would the parachute with the lighter payload fall more slowly?

5. If you were falling through the air, would you rather have a big parachute or a little one? Here are some real-life factors to consider. First, some big parachutes take a long time to open. If you are close to the ground, this could be a problem! Some small parachutes have special designs that allow the user to steer them to a safe landing spot. Look at the parachute designs below. Pick the one you think might be the best. Explain your choice.
  
6. Over the centuries, some creative inventors have worked on parachutes. The best inventors are good observers. They get some of their best ideas from looking at how the natural world solves problems. Compare these animals to a parachute.
  
7. One of the most creative inventors in history was Leonardo Da Vinci. He drew the first parachute design 500 years ago. He never built his parachute, but modern scientists have verified that his idea would work. Compare Leonardo's idea to a more modern parachute.
  
8. Early parachutes had a problem: As they fell, they started spinning in dizzying circles. How do you think inventors solved this problem?
  
9. Advanced parachutes were needed for the space program. Heavy payloads coming in at high speeds were slowed by multiple parachutes. Each big chute had a small one—called a drogue chute—that was used to pull the bigger chute out of its container. Why do you think this was necessary?

10. Today, many parachutes are not actually parachutes—they are parafoils. A parafoil has bag-shaped spaces inside that catch the wind. The fabric then forms a rigid, curved wing shape called an airfoil. Why is it good to have a parachute shaped like a wing?