PARACHUTE

OBJECTIVE:

You will understand the effect of drag and will construct and use a parachute to increase drag and so slow descent.

INTRODUCTION:

A parachute is a rectangular or umbrella-shaped device which, when attached to a person or load, enables slow descent from a height. In a flying aircraft, drag—the tendency for an object to be slowed by air resistance—is usually considered to be a problem which needs to be minimized in order to maintain speed. When falling, however, the aim is to counteract the pull of gravity and so maintain a speed that is safe for landing. A parachute is specifically designed to maximize drag and so reduce speed.

Leonardo da Vinci (1452–1519) is usually credited with having invented the parachute around 1495, although his "invention" did not get beyond the sketch stage. The device would probably have worked, but as far as we know, no one tested the design. The first well-documented safe descent in a parachute was achieved by Andre Jacques Garnerin in 1797. He launched the parachute from a hot air balloon at an altitude of 2,230 feet and, standing in a basket at the base of his parachute, floated safely to the ground. The parachute consisted of an umbrella-shaped canopy of canvas, 23 feet across, attached to the basket by cords.

Throughout the nineteenth century, the parachute was used for descending from balloons to provide a spectacle for onlookers; it was also used as a means of escaping from a balloon in an emergency. In 1912 an American stunt entertainer, "Captain" Albert Berry, developed an unfolding parachute which he used to jump from an airplane at 1,500 feet—an event which aroused little interest at the time. Had a similar device been used a few years later, during World War I, the lives of many hundreds of pilots might have been saved. But it was not until the early 1920s that work began in earnest to develop a parachute that could be used in a moving airplane. The basic design of the modern folding parachute—stored in a pack on the pilot's back and released by pulling a ripcord—was developed by the late 1920s.

Today, parachuting is a sport using the latest technology. Parachutes shaped to form airfoils are used by stunt teams to land on precisely selected targets. Apart from their use as safety devices, parachutes are also used for aerial drops of supplies and equipment to areas that cannot be reached by land, and as braking devices (drogues) to slow dragster cars and high-speed landing aircraft. Here you will explore the effect of surface area and load on the rate of descent of a parachute.

TIME NEEDED:

1 hour

Note: You will need to do this investigation on a day with very little or no wind.

MATERIALS:

Note: You will need a partner for this investigation.

- 4 40cm lengths of thread
- 4 55cm lengths of thread
- 2 square sheets of thin plastic (e.g., plastic garbage bag): 25 cm x 25 cm and 35 cm x 35 cm
- 4 metal washers of the same size and weight
- scissors
- stopwatch
- transparent tape
- 2 paper clips
- metric ruler

Note: Testing requires a clear vertical drop of at least 18 feet. You will need to find a suitable, safe location, such as a second-floor window.

Safety Precautions

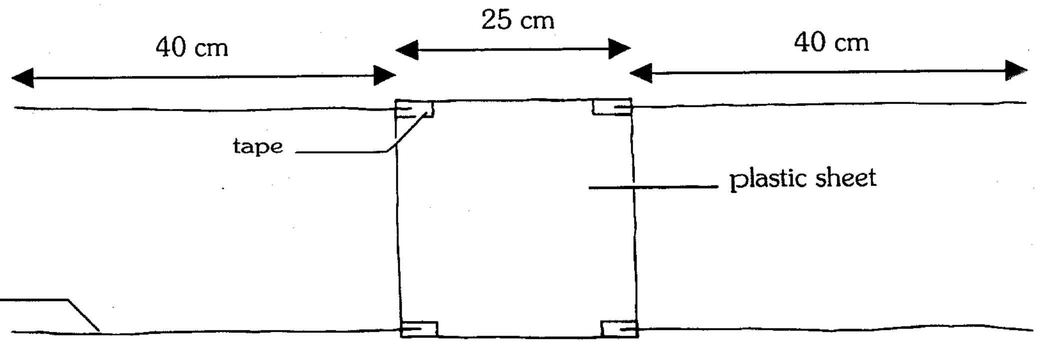
Adult supervision required. Please read and copy the safety precautions at the beginning of this book. Make sure that there is absolutely no danger of you or anyone else falling from the testing height, and that no one will accidentally walk through the testing area.

PROCEDURE:

Part 1—Comparing parachutes of different sizes

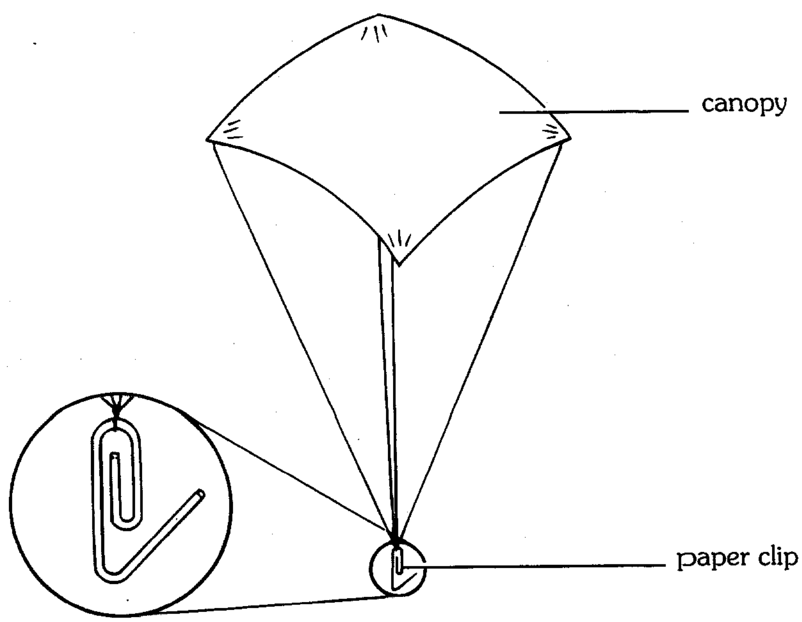
1. To make parachute A, tape a 40cm length of thread securely to each corner of the 25cm-square plastic sheet (see figure 1). The plastic sheet is the canopy of your parachute.

Figure 1



2. Tie the other ends of the threads together, making sure that each thread is the same length. Then tie a paper clip to the joined ends of the threads (see figure 2).

Figure 2



3. To make parachute B, repeat steps 1 and 2 but using the 55cm-length threads and the 35cm-square plastic sheet.
4. Find a safe point, at least 18 feet off the ground, from which to drop the parachutes and test their effectiveness . A second-floor window may be suitable.
5. Hang a metal washer from the paper clip on parachute A. Hold the parachute by two corners, with the canopy extended, out the window so that it is clear of any window ledge. Have your partner start the stopwatch when you release the parachute.
6. Have your partner stop the watch when the parachute hits the ground. Record in the Data Table the time taken for the parachute to land.
7. Repeat steps 5–6 using parachute B.

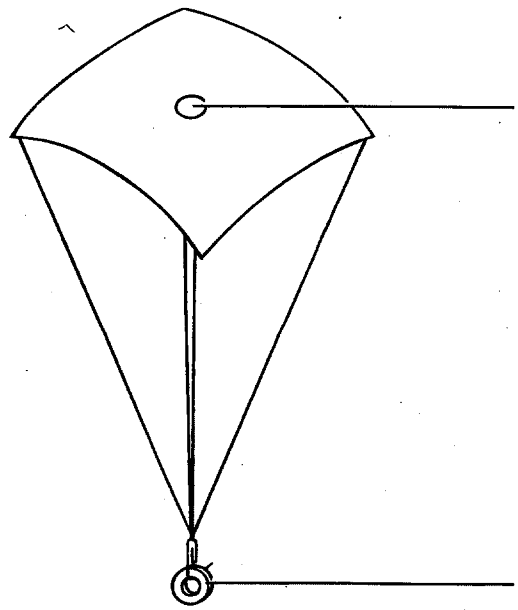
Part 2—Comparing different loads

8. Demonstrate the parachute using three loads of different sizes. Begin by hanging two washers from the paper clip on parachute A and repeating steps 5–6. Then repeat with three and then four washers. Each time, record your results in the Data Table.

Part 3—The effect of a hole in the parachute

9. Using parachute A, repeat steps 5–6 using a single washer as a load, but first make a 3cm-diameter hole in the center of the canopy (see figure 3). Record your results in the Data Table.

Figure 3



DATA TABLE

	Time to land (in seconds)
Part 1	
Parachute A	
Parachute B	
Part 2	
two washers	
three washers	
four washers	
Part 3	
with hole in canopy	

ANALYSIS:

1. Is there a difference in the time taken for parachutes A and B to fall? If so, how do you account for the difference?
2. Does increasing the load on parachute A alter the time taken for the parachute to fall? If so, how do you account for the difference?
3. How does cutting a hole in the center of the parachute alter its speed of descent? Some modern parachutes do have a hole in the center of the canopy. What is the advantage of this? Do you think this hole can be too big or too small? Give reasons for your answers.
4. Do some research. Describe what happens to the speed of a parachutist when she jumps from a plane at 10,000 feet, opens her parachute one minute later, and then floats to a touchdown.

OUR FINDINGS:

Click on above link to see what we found.

SPECIAL SAFETY NOTE TO INVESTIGATORS

Each invention includes any special safety precautions that are relevant to that particular project. These do not include all of the basic safety precautions that are necessary whenever you are working on a scientific investigation. For this reason, it is absolutely necessary that you read, copy, and remain mindful of the General Safety Precautions that follow this note.

Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly when you are constructing or demonstrating a model invention. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following basic safety guidelines the *entire* time you are carrying out the project, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual projects. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note: The book assumes that you will read the safety precautions that follow, as well as those in the box within each project you are preparing to perform, and that you will *remember* them. Except in rare instances, these precautions will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE does not mean that you should be careless when simmering water or stripping an electrical wire. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it.

If you ever have a question about whether a procedure or material is dangerous, wait to perform it until you find out for sure that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while carrying out these projects. Be sure to check the individual projects in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARING:

—Clear all surfaces before beginning projects
—Read the instructions before you start
—Know the hazards of the procedures and anticipate dangers

PROTECTING YOURSELF:

—Follow the directions step-by-step; do only one project at a time
—Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eye wash, and first-aid kit
—Make sure there is adequate ventilation
—Do not horseplay
—Wear an apron and goggles
—Do not wear contact lenses, open shoes, loose clothing, or loose hair
—Keep floor and work space neat, clean, and dry
—Clean up spills immediately
—Never eat, drink, or smoke in laboratory or work space
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USING EQUIPMENT WITH CARE:
—Set up apparatus far from the edge of the desk or bench
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs
—Clean glassware before and after use
—Check glassware for scratches, cracks, and sharp edges
—Clean up broken glassware immediately
—Do not touch metal conductors
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders
—Never look directly at the sun with your observation devices

USING CHEMICALS:
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly

HEATING SUBSTANCES:
—Use goggles, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—Turn off hot plates, bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Have fire extinguisher on hand

FINISHING UP:
—Thoroughly clean your work area and glassware
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residue and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws

BE SAFETY CONSCIOUS AT ALL TIMES