



What Goes Up Must Come Down: Are All Parachutes Created Equal?

An Inquiry based on “Making, Testing, and Observing Parachutes”
The Exploratorium Institute for Inquiry

TEACHER PAGES

Objective

This inquiry on parachutes is designed to provide learners with an opportunity to do an inquiry that focuses on becoming familiar with inquiry and developing skills necessary to being successful learning science through inquiry. While the learners will come away with new or expanded content knowledge, the learning of content is de-emphasized in this particular inquiry and becoming familiar with inquiry and learning the process skills are emphasized.

A section at the end of these teacher pages is included which addresses how to modify the inquiry activity so it emphasizes content goals more fully.

Inquiry Overview

The students will begin the activity by all making a “standard” parachute and “testing” it. After a short period of testing and observing the students will work in small groups first and then as a whole class to list questions that they have about parachutes. A whole class discussion will follow to determine which questions are investigable and which are not, given time constraints, availability of materials and so forth. Also, some non-investigable questions may only involve library research. Student teams of three or four will then decide on one of the questions to investigate, carry out the investigation and report on the results to the rest of the class. Depending on your class this inquiry may take up to 3 class periods.

Materials (per 30 students)

PART 1

- 60-80 light weight 10” party napkins
- 400 adhesive dots
- 1 box of jumbo paper clips
- Thin string cut in 20-25 cm lengths

PART 2

- 15 rulers
- 15 scissors

Have as many of the following as possible available for students to use:

- Several different kinds of string not cut-students will cut the lengths
- 1 roll of wax paper

PART 2-continued

- 1 roll of aluminum foil
- 1 box of small washers
- 1 box of large washers
- Plastic garbage bags
- Plastic grocery bags
- Newspaper
- Larger napkins
- 1 yard pieces of various kinds of cloth
- Other materials (optional)
 - ✓ Mylar
 - ✓ Plastic
 - ✓ Construction paper
 - ✓ Tissue paper
 - ✓ Masking tape

Suggested Inquiry Approach

In advance of doing the lesson, cut 4 pieces of the light weight string into 20-25 cm lengths. Cut enough so that each student will be able to make his or her own parachute. Make-up one parachute to use as a model and to demonstrate the construction and testing.

Also find a place in your school that has high enough ceilings so that when the parachutes are tossed into the air they will not hit light fixtures or the ceiling. It is not recommended that this activity be done out of doors due to the variable nature of the outdoor conditions.

Have a place available in your room to put out all of the materials for Part 2 when you get to it.

Part 1

Start the lesson by telling the students that they will have the opportunity to observe and explore parachutes and each group will make a standard one like the one you have made (show your parachute).

Hand out the Part 1 student sheet and tell the students that you will all work through the directions for making the parachutes together, with your parachute as a model. Demonstrate the launch technique for them.

When all are ready to test, ask the students what sorts of things they should be observing. Try to elicit as many responses as possible—don't offer any ideas unless they are totally stumped. Some possible examples might include: drop time, behavior/shape of the canopy as it drops, position of the paper clip, how/where the parachute lands.

Although each student will have an opportunity to test his or her own parachute, teams of 2-3 testers should be formed to allow for discussion about what they are observing.

Allow about 10 minutes for the students to test. Remind them periodically during that time to remember to record their observations and perhaps any questions that come up.

After all have tested several times and recorded observations, return to the classroom. Ask the groups to spend a few minutes organizing their observations and perhaps add to them if necessary. Drawings in some cases may be easier than words to describe an observation. Next as a whole class ask students to share and discuss some of the things that they observed.

Finally have the teams discuss the questions that they might have about the parachutes and write them in the appropriate place on the student sheet. Encourage all groups to come up with at least 3-4 questions and be ready to share with the class.

When all groups finish writing their questions, have each group share one with the class. Write each shared question on chart paper or on an overhead transparency (you may need to save them for the next class period). Have each group share two times or until you have 8 to 10 questions listed.

Refer to the list of questions and tell the students that they will need to make a distinction between two kinds of questions: investigable questions (those that can be investigated) and non-investigable questions. To clarify you may tell them...

- **Investigable questions** are those you think can be investigated by doing something concrete with tools and materials.
- **Non-investigable questions** are those you think cannot be answered by investigating with tools and materials

Also some non-investigable questions may require too much time or materials that would be difficult to find.

Ask them to look at the first question and ask them if they can think of a way to investigate that question. Proceed to each question and ask the same question for each. Mark each that they think is investigable with a star or a check.

Part 2

Before starting Part 2 spread out the materials you have for this part on a table or counter for easy access by the students.

In this part of the lesson each team of students will decide upon the question they would like to test. Hand out the Part 2 student pages and tell them that this is a template for planning their investigation. Tell them that they should choose a question that they really want to investigate. Then think about the materials they might need and plan the steps they will need to follow. Tell them that sometimes after the investigation starts they may find that they will need to refine their plan, and that's okay.

Also, have a brief discussion about making their tests “fair”—by only changing one variable at a time. For example if they are testing to find out if the material that makes up the canopy makes a difference, then each canopy should be the same size.

Show them the Part 2 materials that you have spread out for them to use.

Ask the teams to record their question, materials and plans and show them to you before getting any materials. This way you have the opportunity to encourage the students to refine their plans if needed before they actually start their investigations. Also, depending on your time frame it may allow for the students to bring in additional materials that they might test.

Each team member should make a parachute that will test the variable that they have chosen in their question. So if the material of the canopy is what they are testing each will make a parachute with a different material for the canopy.

As the students are making and testing their parachutes circulate among the groups and try to notice whether what they are doing is likely to help them answer their questions or not. So for instance, if they are investigating whether the material the canopy is made of makes a difference, but each team member is making a different sized parachute—this means they have confounded their variables and will have a difficult time knowing whether or not the material makes a difference. You might say to this group something like, “I noticed that your parachutes are different sizes. Do you think the size of the parachute might make a difference and is that something you want to find out?” This approach brings up the point without flat out telling the students that they are doing something wrong.

Once everyone has had sufficient time to do their investigations, have all go back to their classroom and work on clarifying their observations and writing a conclusion. Tell the students that they will need to think about two important things while they are working together: 1) think about what the results tell you about your question and how you will communicate your findings to the rest of the teams.

Tell the students that each team will prepare a brief (no more than 2 minutes) sharing of their investigation and that they should start by stating their question; if they answered their question, how did they do that and what evidence to they have; if they weren't able to conclusively answer their question, tell us what they did find out and what they might do next. Also each group should come up with a new question or two based on their investigation.

Allow about 15 minutes for the team discussion and preparation for the sharing.

Before the sharing, set norms for listening to the presentations, such as looking at and listening to the presenters without side conversations and the presenters will speak loudly and clearly.

Ask for volunteers or give each group a number and draw numbers out of a "hat". Give a signal when 2 minutes have passed to let groups know to wrap it up quickly. When each group is finished ask if there are any questions from the other groups.

Debrief

After all groups have finished their presentations discuss with the entire group some of the things they might have learned about parachutes and also about doing inquiry.

You might ask:

- What did you learn about parachute construction? (the materials used; the weight; the shape of the canopy; and so forth)
- What did you learn asking good questions? (investigable versus non-investigable)
- What makes for a good investigation plan?
- What makes for a good investigation presentation?



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PART 1

PROBLEM:

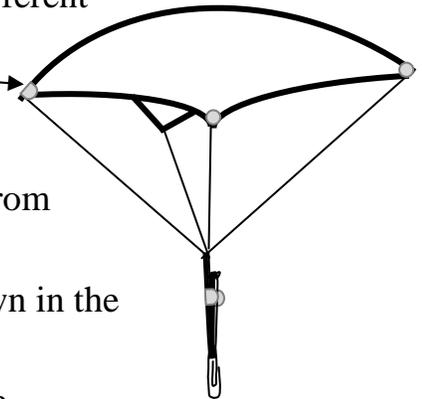
What observations can I make about how a parachute floats to the ground?

MATERIALS:

- 1 small square napkin
- 4 pieces of string each 45 cm long
- 1 large paper clip
- 5 sticker dots

PROCEDURE:

1. Use 4 of the sticker dots to secure one end of each string to a different corner of the napkin.
2. Bring the 4 free ends of the strings together and run them through the paper clip.
3. Fold the strings up to form a loop. The paper clip should hang from the loop.
4. Wrap 1 sticker dot around the strings to secure the loop, as shown in the picture at the right.
5. Pull the parachute up in the center and make it as flat as possible.
6. Fold the parachute twice (as demonstrated).
7. Lay the strings with the paper clip on top of the folded parachute.
8. Throw the parachute up into the air with paper clip side up, using an underhanded toss.
9. Observe the motion of the parachute and write detailed observations in the “Observation” section.
10. Toss and observe. Write additional observations several more times.





OBSERVATIONS:

WHAT QUESTIONS DO YOU HAVE ABOUT PARACHUTES?

Work with your team to come up with as many questions as you can about parachutes. Be prepared to share them with the rest of the class.



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PART 2

PROBLEM:

Write the question you and your team decided to investigate:

It is important to answer the following questions before proceeding with your investigation.

- What are the parts of the parachute and the way you launch it that will stay the same?
- What is the one thing about the parts of the parachute and the way you launch it that you will change?
- What will you observe or measure to answer your question? (e.g. speed, accuracy, path of descent, etc.)

MATERIALS:

List the materials needed for your investigation.



PROCEDURE:

List the steps you will use to complete your investigation

OBSERVATIONS AND DATA:

DISCUSSION AND CONCLUSIONS:

Describe what you found out and why you think it happened.