



Forces Lesson 4: Resistive Forces - Air Resistance

Learning Objective:

To investigate air resistance in parachutes.

Success Criteria:

- To describe the effect of air resistance on an object.
- To investigate how the size of a parachute affects the time taken for a paperclip to fall.
- To evaluate an investigation.

Context:

This is the fourth lesson in the KS3 Forces topic. Students are introduced to air resistance by investigating how the size of a parachute affects the time it takes for an object to fall.

Resources

material to make parachutes from (e.g. bin liners, cloth, carrier bags)
string
paperclips
stopwatches
sticky tape
glue
scissors

Starter

The slide tells students about Galileo's observation that gravity causes all objects to fall at the same rate. A video of a feather and a hammer being dropped on the moon to demonstrate this is shown on the [slide](#). The students are asked why the same thing doesn't happen on Earth. You are looking for them to identify the role that air resistance plays here.

Teacher Note: We hope you find the information on our website and resources useful. This resource contains links to external video websites. These websites often have autoplay features meaning that other videos will play after the video you are watching finishes. You should disable this feature before using the video in any classroom or similar setting. Twinkl assumes no responsibility for the contents of linked websites. The inclusion of any link in this resource should not be taken as an endorsement of any kind by Twinkl of the linked website or any association with its operators. We have no control over the availability of the linked pages. If the link is not working, please let us know by contacting TwinklCares and we will try to fix it, although we can assume no responsibility if this is the case.

There is an explanation of the hammer and feather phenomenon on the following slides. Students do not need to understand this explanation completely but should recognise that air resistance affects objects differently depending on their mass and surface area. The diagrams only show a snapshot of the forces but illustrate the fact that the forces on the feather become balanced more quickly than the forces on the hammer.

Main Activities

Air Resistance:

The slides introduce students to air resistance as a drag force. The illustration shows that moving objects must displace air particles in order to move into that space and this is what causes the drag force. Students are shown three objects and are asked in which direction air resistance will act. You could use mini-whiteboards to assess the understanding of the whole class or ask students to draw their answers on the [Air Resistance Illustrations](#), which can then be stuck into their exercise books.

Investigating Air Resistance:

Students use parachutes to investigate air resistance. There are instructions provided to make parachutes of 4 different sizes on the [Investigating Parachutes Method Sheet](#). Bin liners work well as the material for this activity but you could use other lightweight materials that you have available. We have used paperclips as a weight for our parachutes but you could use any small objects that you can attach easily to the string.

Students drop their parachutes from a suitable height and record the time taken for the parachute to hit the ground. Please be aware of any potential safety risks involved in undertaking this experiment.

Teacher Note: We hope you find the information on our website and resources useful. The activities set out in this resource are potentially hazardous. The activities are not suitable for all children and adult supervision may be required for some of the activities. It is your responsibility to assess whether the children in your care are able to safely carry out the activities and whether the children require adult supervision. You are responsible for carrying out proper risk assessments on the activities and for ensuring that activities can be carried out safely. We are not responsible for the health and safety of your group or environment so, insofar as it is possible under the law, we cannot accept liability for any loss suffered by anyone undertaking the activity or activities referred to or described in this resource. It is also your responsibility to ensure that those participating in the activity are fit enough to do so and that you or the organisation you are organising for has the relevant insurance to carry out the physical activity. If you are unsure in any way, we recommend that you take guidance from a suitably qualified professional.

A differentiated results table is provided on the **Air Resistance Worksheets**. The HA worksheet provides students with a blank table, the MA sheet has prompts for some of the headings and the LA table has headings completed with gaps for students to insert units. There is a **Table Checklist** provided for students to use as a guide or for self-assessment if you think it would be helpful for your group. There is a table on the **PowerPoint** that includes some mock results and support to help students calculate a mean. The second table slide identifies an anomaly and shows students how to calculate the mean without it.

It would be a good time to recap with students why it is necessary to take repeat readings in investigations. Many students will have misconceptions that repeating an investigation makes it a fair test or more accurate. In fact, taking repeat measurements reduces the effect that random errors will have on the calculation of a mean. Therefore, the more repeat measurements you take, the more accurate the mean will be. Students need to be clear that it is the mean that is more accurate; not the results.

Conclusion and Evaluation:

Students are asked to describe what their results show, including some data, and to explain why this happens using their scientific knowledge. The **MA Worksheet** guides students through writing a conclusion with the questions that are on the slide. You may also show these questions to students answering on the **HA Worksheet** if you think they would benefit. The **LA Worksheet** includes sentence starters and key words for support.

The slides guide students through the scientific terminology that is common when evaluating an investigation. Students often struggle to use the keywords appropriately, so it is worth taking time to work through the meaning of the terms and when they should be used. The **Air Resistance Worksheets** break down the evaluation into the questions on the slides, while the **LA and MA Worksheets** also include the definitions of key words.

- Conclusion three only discusses a decrease between two adjacent data points, this isn't enough to identify a pattern. Students should identify a decrease consistent between all data points or use data that supports the overall trend.
- The name of the force should be identified, rather than just saying 'the force', which could be one of many.
- Students should make the link between the size of the parachute and both the speed at which it falls and the size of the air resistance.

You may wish to give students the chance to adjust their conclusions in a different colour based on this activity.

Plenary

Conclusion and Evaluation:

Four conclusions are given on the slide that describe the relationship in the investigation. Students are asked to rank the conclusions. There are positives and negatives about all the conclusions so the students may rank them differently and this is okay. The activity should prompt some meaningful discussions about what makes a good conclusion

Some possible discussion points:

- Students should have included data to support any patterns that they identified in their results.
- Students should be encouraged to use scientific language, so should be using terms like increase and decrease rather than goes up and goes down.