

## Inseparable Books

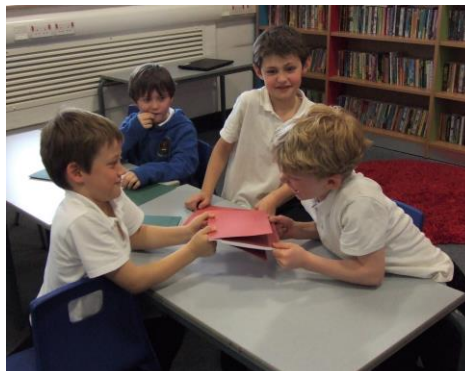
### Why do this?

Children will be surprised that it is really difficult to pull two books apart when you interleave all of the pages. This activity provides children with a way of experiencing the force of friction and how strong it can be.

Curriculum links: *force, friction*

### Suitability

Years 3-6



### Practical details

This activity has been prepared using CLEAPSS guidance. If in doubt, or for further information, contact CLEAPSS.

#### Safety

- There is a risk that children will fall backwards if the books separate or if they lose their grip. Warn children to be sensible when pulling to avoid injuries.
- Ensure children are standing in an area where if they fall backwards, they will not collide with other objects e.g. bookcases or desks.
- If using force-meters tell the children to hold the equipment at arm's length at all times.

#### Equipment per pair of children

2 equal sized books or magazines (a minimum of 50 pages thick is recommended)

#### Notes

- A variety of shapes, sizes and types of books will work providing each pair is similar.
- The books may get damaged so choose books carefully.

#### Procedure

1. Take two books and place them on a table with their spines facing outwards.
2. Position the books so that the covers almost completely overlap.
3. Place a page from one book over a page from the other.
4. Continue until you have interleaved all of the pages.
5. Hold the books by their spines and see if you can pull them apart.



## Expected observations and results

Even when using all their strength it is very difficult for two people to pull the books apart. Glossy magazines (which have smoother paper) will pull apart more easily but will become inseparable if enough pages are interleaved.

## Possible further activities

- Ask the children for suggestions of things that they could change about the activity, for example:
  - How many pages need to be overlapped for the books to become inseparable?
  - Does the type of paper make a difference?
  - Does the amount of overlap make a difference?
- Hole-punch one (or both) of the books and use a force-meter (or a variety of different force-meters) to measure the force being applied.



## Background notes

Friction is a force between two surfaces that are sliding, or which are trying to slide, across each other. Friction always works in the direction opposite to the direction in which the object is moving, or trying to move.

The amount of friction between two sheets of paper is small but when you interleave all the pages of a book, the number of surfaces in contact increases greatly and therefore so does the amount of friction. As you try to pull the books apart each book tries to close. This squeezes the pages more tightly together increasing the amount of friction between each page even further.

The more pages a book has the greater the force required to separate them. There are many examples online showing forklifts, cars and even tanks trying to separate interleaved telephone directories.