



## Methods

This study is using a multiphase mixed methods design. This means that both qualitative methods (such as interviews) and quantitative methods (such as statistical analysis) are being used. The results of the earlier phases will feed into the later phases.

ONE

**Physics Teacher Interviews**  
Aim: to identify which physics topics students find the most tricky by conducting interviews with six physics teachers.

TWO

**Physics Teacher Questionnaires**  
Aim: to break down the topics identified in phase one in more detail and create a quiz to investigate students' understanding of those topics.

THREE

**Student Interviews**  
Aim: to check the validity of the findings so far by interviewing students.

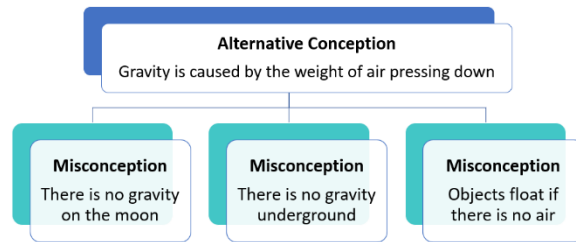
FOUR

**Student Quiz**  
Aim: to use a quiz to examine students' understanding of the tricky physics topics that have been identified and to look for patterns, such as if there are links between different misconceptions.

## Rationale

Students frequently find physics difficult and teachers often do not know why. The teacher can give the student all the information they think the student needs and the student still does not understand it. This research project is investigating how students develop an understanding of these particularly tricky physics topics with the aim of producing some useful teaching resources.

Students' ideas about science are complex and interconnected. They often have their own incorrect theories about the way the world works (called 'alternative conceptions'). A single alternative conception can lead to multiple misconceptions:



## Findings So Far

The interviews with physics teachers for Phase One have been completed and analysed. The tricky physics topics identified for further research in Phase Two are:

### Electricity, Forces and Radioactivity.

Electricity and forces have often been identified by past research as tricky topics for students to learn, but there has not currently been much research into students' understanding of radioactivity, so this is an interesting finding.

Even though teachers from two different schools were interviewed, their students have similar issues and the same misconceptions (such as confusing the nucleus or a plant/animal cell with the nucleus of an atom and thinking an atom has DNA).

## What Makes Physics Difficult?

Research, including this study, indicates that students often find physics difficult because:

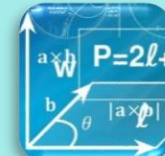


Physics concepts (e.g. forces) are often abstract so you cannot see or touch them.



Our everyday experiences sometimes conflict with scientific theory.

For example, most of us only experience gravity on Earth, so students sometimes think that gravity on other planets must be exactly the same. In fact, gravity is stronger on bigger planets and weaker on smaller ones.



Students frequently struggle with maths, such as equations.



Students pick up bad science from everyday sources such as movies or even past teaching.

### Motivated Reasoning

Once a student has a misconception, it's really difficult to get rid of it because of motivated reasoning.

This is when people apply their reasoning in a one-sided manner that supports and rationalises their beliefs while rejecting information that doesn't fit in with their beliefs.

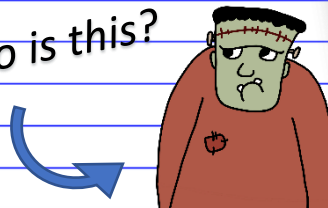
IT'S FAKE NEWS!

### EXAMPLES

Refusing to believe in climate change despite the scientific evidence is a good example of motivated reasoning. Scientists are also more likely to accept results which fit in with their own beliefs.

### Frankenstein Thinking

Who is this?



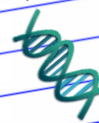
Lots of people think this character is called Frankenstein, but it's actually Frankenstein's monster.

Dr Frankenstein is the one who created the monster.

Teachers and researchers often assume that misconceptions like this are easy to fix by simply giving students the correct information, but it often doesn't work like this with science as students simply reject what their teachers tell them.

A lot of research just lists students' misconceptions, which isn't enough. We need to look for the causes of misconceptions.

Why are some people so smart?  
Intelligence is influenced by more than DNA.



There seems to be a link between students enjoying a subject and them being motivated to learn about it.  
**Note: Having fun is therefore important!!!**