



HOW I TEACH... FORCES

Carole Kenrick is an experienced physics specialist science teacher in both primary and secondary, with a decade's experience in training teachers.

Research and Anticipate

Mistakes vs misconceptions

Mistake:
Not knowing, misremembering or misunderstanding something

Misconception:
Knowledge or observations misapplied or over-generalised

" $F = m / a$ "

"All metals are magnetic"

If we just teach students what they need to know and not the reasoning process, they tend to continue their original reasoning, even after you've taught them the right answer.

Researching and anticipating misconceptions

I use resources, such as the IOP Spark site, to find common misconceptions before I teach a topic.

"If an object is moving then there must be a force acting on it."



In everyday situations, if you want something to keep moving you have to keep exerting a force on it, due to resistive forces such as friction and air resistance.

Before the lesson, I think about scaffolding questions:

- Why does a ball stop rolling along the ground?
- What would happen if there were no friction or air resistance?

Diagnose and Address

Using thought experiments

One strategy I use to find out how students reason about forces is "force spectacles", an example of a thought experiment. Physicists often use thought experiments to think through something they can't do or see in real life.

"There are forces acting in each of these situations. I'm going to ask you to put on a pair of force spectacles. They will turn the forces you can't see into forces you can see!"



A paper plane flying through the air



A football just after it has been kicked



A boat travelling at a constant speed

Modelling thinking

I model the thinking of a physicist, asking questions I ask myself when thinking about forces. I use the precise scientific language I expect students to use.

"Which object is the force exerted by?"

"What kind of force is it?"

"Which object is the force acting on?"

Assess and Review

Refutation texts

To help pupils recognise how their ideas have changed, I use post-it note reflections.

I used to think that...
Now I know that...

I used to think that...
forces keep things moving.

Now I know that...
an object will keep moving until a resultant force acts on it.

Address and assess in various contexts

Misconceptions tend to reappear if you don't revisit them, because students will revert to their intuitive reasoning. I help pupils practise new ways of reasoning in a variety of contexts, for example using concept cartoons and diagnostic questions.

"What if there were no air resistance, friction, or gravity? What would happen to a feather and a bowling ball dropped from the same height?"

