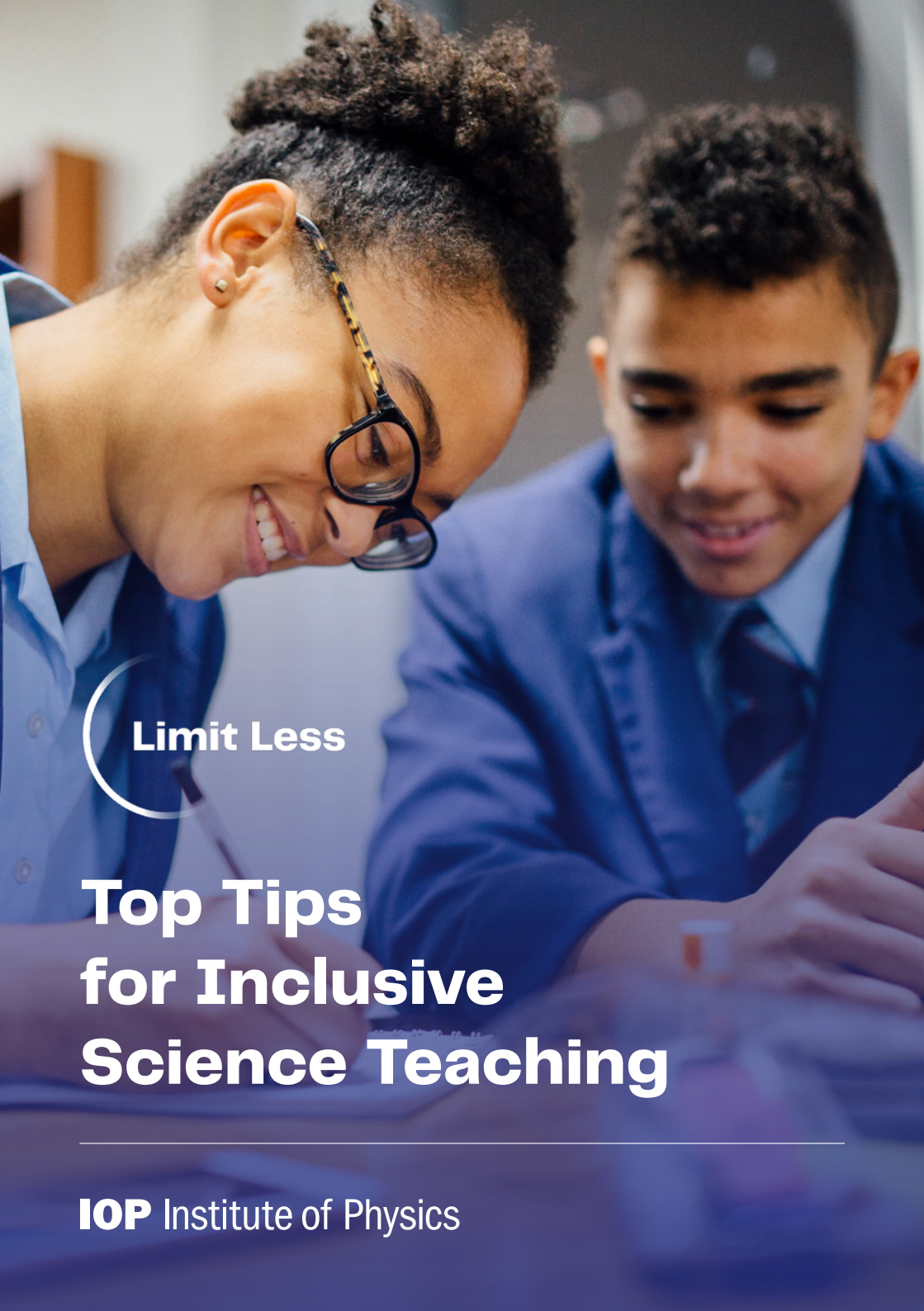


Limit Less

Top Tips for Inclusive Science Teaching

IOP Institute of Physics

Limit Less and inclusive teaching

How can we make sure that all students feel they belong and have what they need to thrive?

At the Institute of Physics, our work is driven by the urgent need to address the fact that there are far too many people missing from our community. We know that many young people are put off studying physics after the age of 16, not because of a lack of ability or interest in the subject, but because of prevailing social attitudes that discourage them. Young people are exposed to the widespread misconception that physics is a subject for other people, perhaps people who they're told are cleverer than them, or who come from more privileged backgrounds or particular social and ethnic groups. This leads to many young people being told by those they trust, or reaching their own conclusion, that *'physics is not for them'*.

This view is reinforced from all around – be it from the education system, parents and carers, or among local communities and wider society. This must change. Limit Less is the campaign that aims to encourage and support young people to change the world and fulfil their potential by doing physics. It seeks to challenge the misconceptions and stereotypes about the subject and remove the barriers to young people doing physics beyond the age of 16.

The Limit Less campaign has identified five groups that are currently underrepresented or underserved in the physics community. These young people are less likely to do physics and more likely to face a hostile environment when they do. These groups are:

- Girls
- Young people from disadvantaged backgrounds
- Disabled young people
- LGBT+ young people
- Young people of Black Caribbean descent

If we want to build a thriving physics community, it's vital that we encourage more young people from diverse backgrounds to choose physics. We know that variety of experience and thought makes for better physics, and a better contribution from physics to solving the global challenges we face. This physics community will make a greater contribution to our economy, creating more jobs and growth. Importantly, we know that choosing to do physics gives young people the tools to understand their world and shape their future.

Your commitment to supporting the young people you work with means you have the daily opportunity to communicate the messages of the Limit Less campaign and to be an active part of the wider systemic change that's desperately needed.

The inclusive environment you create in your classroom needs to be part of an inclusive school, and that's why we're campaigning for all schools to have a whole-school equity approach and plan to removing the barriers that too many young people face.

Please add your voice to Limit Less to ensure that your commitment to inclusion is part of a bigger wave of systemic change in education and beyond: campaign.iop.org/manifesto

Contents

About this booklet

This booklet is designed to support you with practical ways to make your teaching, interactions and classroom as inclusive as possible. You'll find nine guiding principles for inclusive teaching, arranged under the three themes of:

- Creating an inclusive classroom culture
- Making the learning relevant
- Building numeracy and literacy for science.

We explain why each principle is important and share some immediate practical steps you can take to put them into practice. There's also space throughout for you to write your thoughts and ideas, plan what you'd like to try out, and reflect on what works well in your classroom – we hope it will become an active document.

We've drawn on research including the Science Capital Teaching Approach and the IOP's own longstanding work on girls' participation in physics. To access further reading and to explore the evidence base, use the QR code found on the back cover of this booklet.

1

Enable all students to participate

Some students relish classroom discussions and practical activities while others may need alternative ways to participate.

Ideas to try...

Recognise students' effort and reasoning, not just correct answers, in order to build a culture where it's OK to make mistakes.

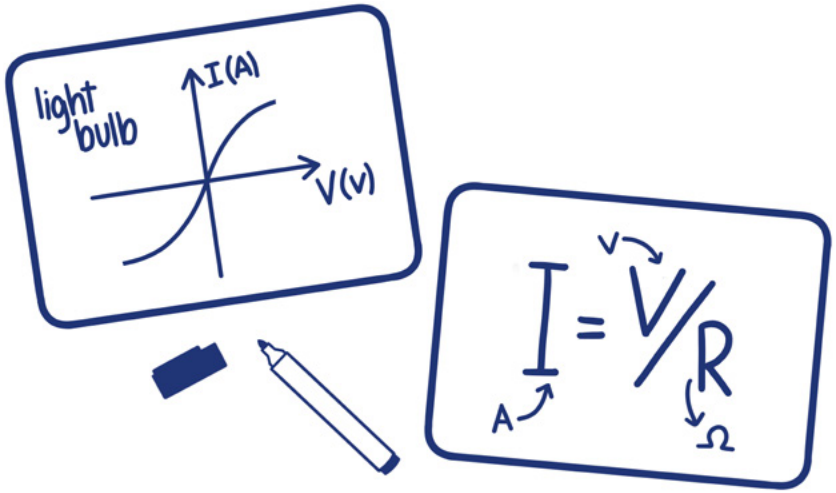
Use think-pair-share: give students time to think, then discuss their ideas with their partner in a low-pressure way, before sharing with the whole class.

Use mini whiteboards to encourage participation.

Use role cards for practical and group work so everyone is involved.

Use a visualiser to show demonstrations more safely and accessibly.

Use high contrast and a colour-safe palette, especially for graphs, for students with colour vision deficiencies.



Mini whiteboards can give students confidence to share their knowledge and understanding, and develop their thinking in a low-pressure way.

Notes and reflection

2

Examine and challenge stereotypes, biases and assumptions

It's important that teachers and students have a broad view of what science is, what scientists are like, who belongs in science and future pathways.

Ideas to try...

Critique the culture of science / representation in the history of science and what a 'good scientist' looks like.

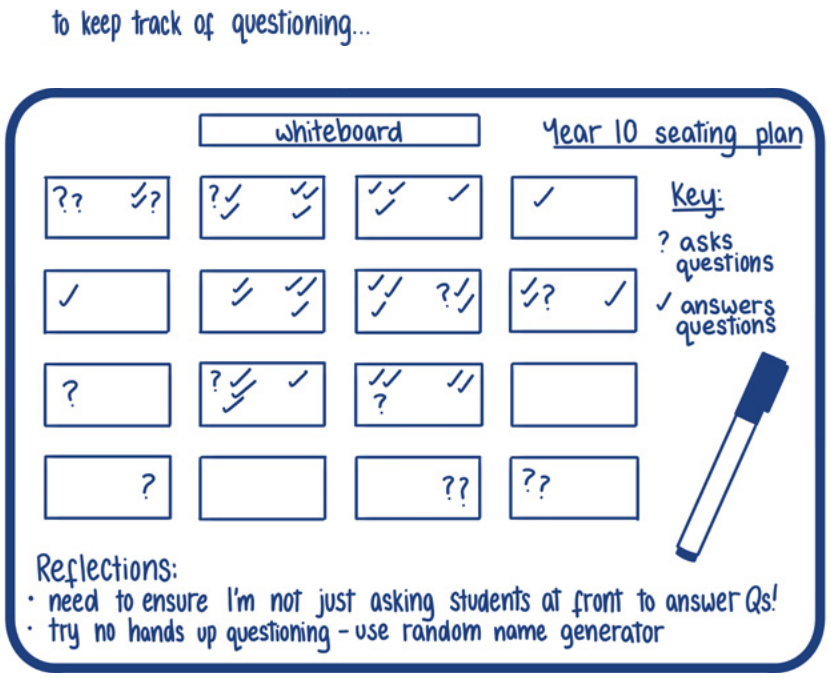
Ask someone to keep a tally of interactions from different groups of students during a lesson. You may find some groups dominate while others are underrepresented.

Audit slides, wall displays and written resources to ensure diverse representation.

Embed examples of people from a diverse range of backgrounds doing science jobs.

Use examples of how science knowledge and skills are used in other contexts like music, sport and cooking.

Notes and reflection



Ask an observer to keep track of who answers and who asks questions in your lessons. Use a seating plan to keep a record.

3

Model inclusive language and expect it from students

All students should feel safe and that they belong in your class.

Ideas to try...

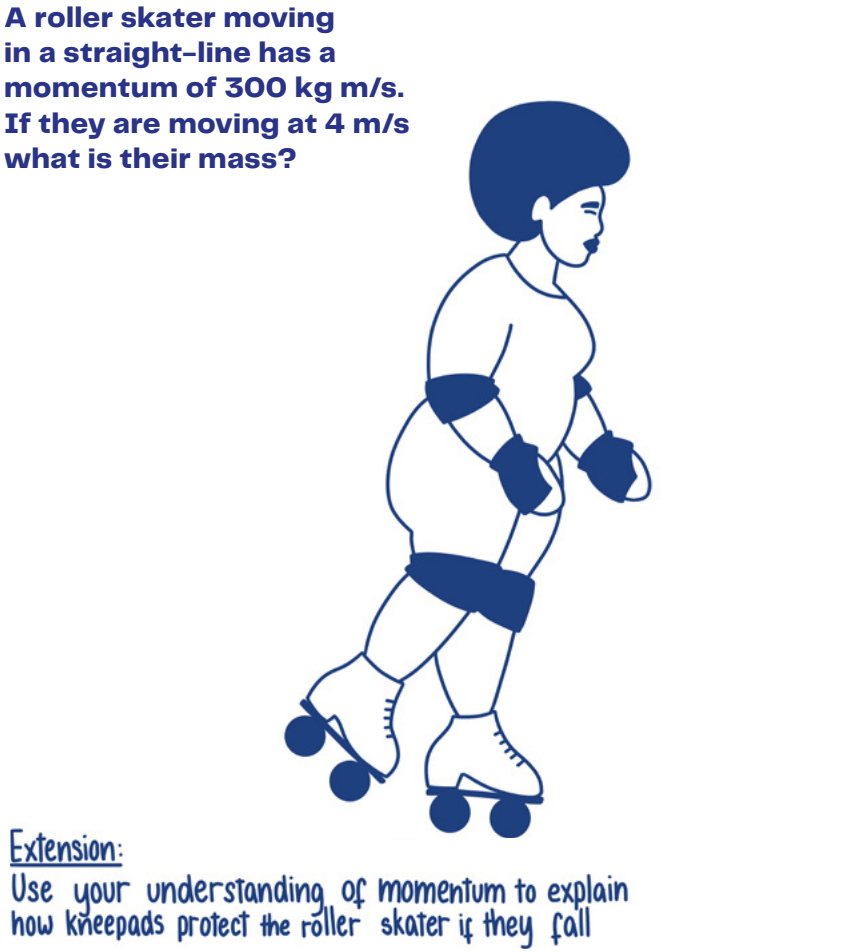
Challenge any discriminatory language.

Make sure your own language doesn't reinforce stereotypes.

Think carefully about how you use pronouns and vary the pronouns you use in examples.

Find out more about your students' identities and cultures to enable you to draw on a broader range of inclusive examples.

Notes and reflection



Choose examples, names and pronouns that challenge stereotypes.

4

Value students' existing knowledge and experience of science

If students don't feel that people like them 'belong', it's difficult for them to feel competent and confident in science.

Help students to recognise themselves as someone who is 'sciencey'. Identify each student's unique knowledge and expertise that's relevant to science - recognise, value and build on it!

Ideas to try...

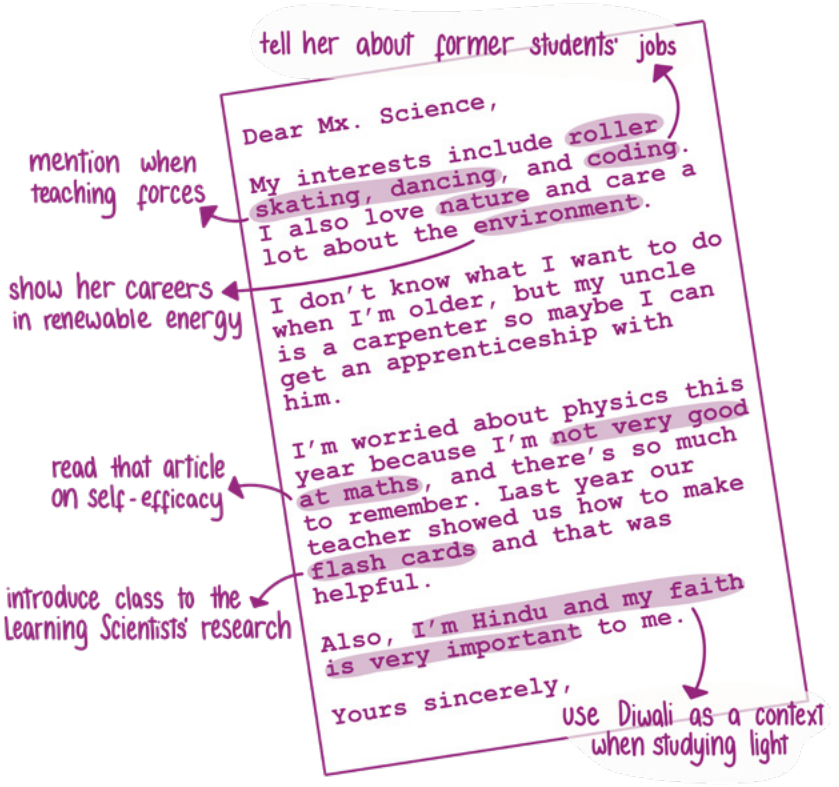
Find out your students' interests, aspirations and attitudes towards science by asking them to complete a questionnaire or write you a letter.

Start a new topic by establishing students' prior knowledge.

Make time for students to offer contributions from their own experiences, interests and identities, knowing that they'll be valued.

Give students opportunities to reflect on how their understanding has developed.

Notes and reflection



Ask students to write a letter introducing themselves, their interests and goals. Use this to inform contexts for learning.

5

Teach about a range of jobs and careers that use science and science skills

Students are more likely to continue to study science if they can see it will help them with jobs they might want to do in the future.

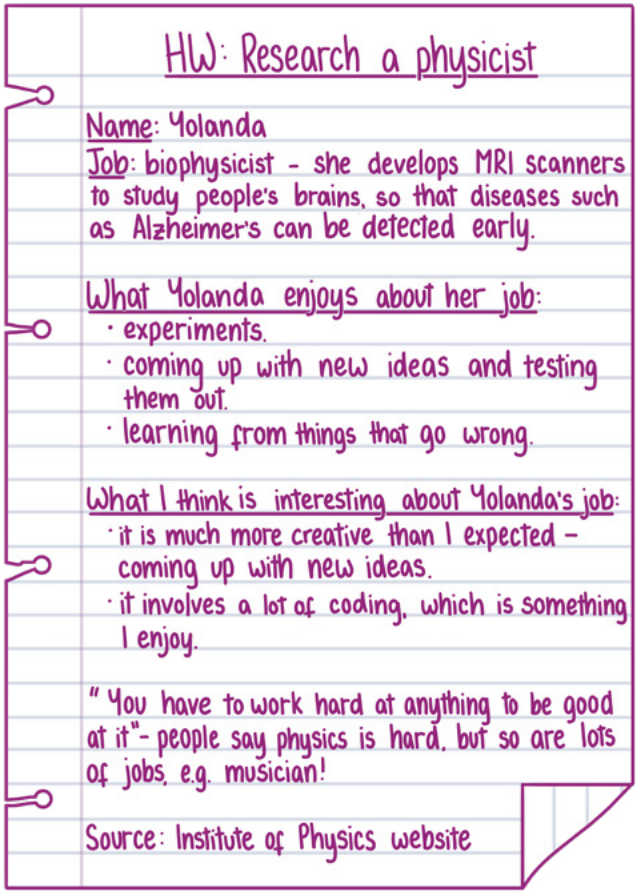
Ideas to try...

Embed into your curriculum and resources:

- Jobs and careers in science.
- Jobs and careers that use science.
- Examples of science-related academic pathways.
- Examples of science-related vocational pathways.

Share the experiences of former students' science-related pathways where possible.

Invite former students and parents / carers doing science-related jobs to talk about their work and pathways.



Set students a task to research a physicist or a physics-related job.

Notes and reflection

6

Give students opportunities to make links between their learning and their lives, interests and local area

Students are motivated when they can see how the learning is relevant to their lives. Having a sense of why something matters supports understanding.

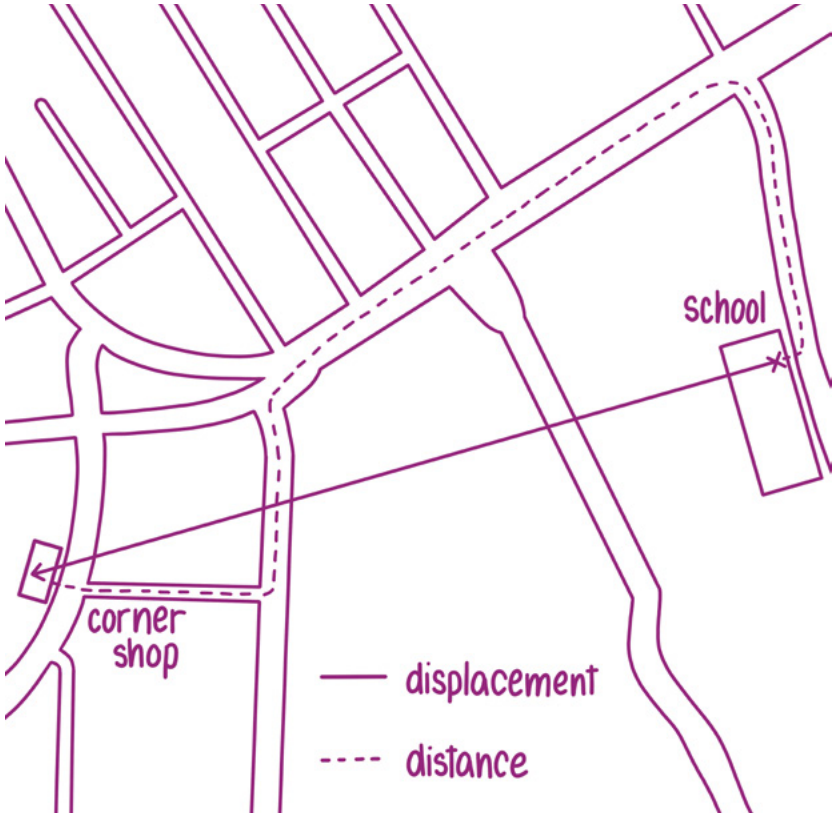
Ideas to try...

Use knowledge of your students' interests and future goals to include examples and contexts that are relevant to their lives.

Make use of photos and maps of your school and its locality in your teaching.

Link to local industries and employers.

Make learning relatable by using familiar objects and materials.



Draw on your school's local area for contexts and examples.

Notes and reflection

7

Build scientific vocabulary

There's a correlation between students' literacy levels and their science attainment.

Ideas to try...

Start with everyday language, models and analogies to build understanding of concepts before introducing technical language.

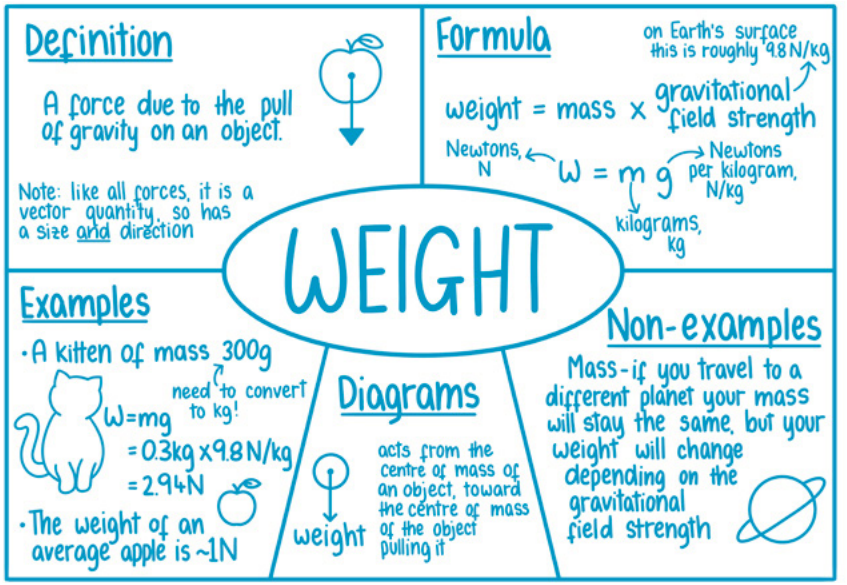
Identify key words for each topic and explore their meaning with students; for example, using Frayer models.

Share the construction, roots and stories behind key words.

Regularly review vocabulary from previous topics.

Use quizzes, spelling/meaning tests and synoptic questions to regularly review key vocabulary.

Notes and reflection



Use Frayer models, such as this one, to help students develop their understanding of key words.

8

Get students talking and listening

Oracy builds students' understanding and confidence to use scientific vocabulary and helps them rehearse answers in preparation for writing.

Scaffold discussions so all students are able to communicate scientifically.

Ideas to try...

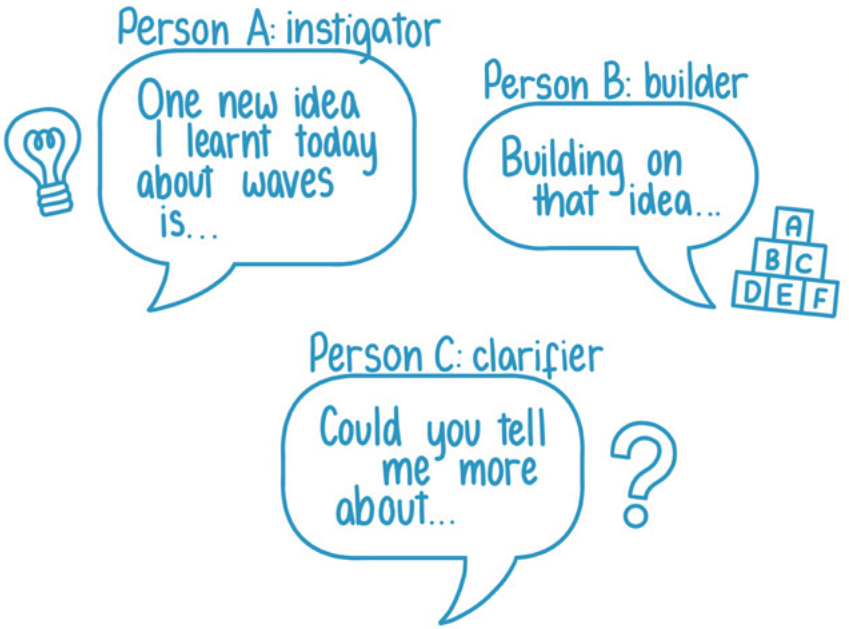
Communicate expectations and protocols for talking and listening.

Provide sentence starters or questions.

Use think-pair-share as a questioning strategy.

Assign roles to support active listening.

Invite students to challenge and build on each other's answers.



Give clear expectations for talking and listening.

Notes and reflection

9

Make time for maths

Remember that maths is often taught differently to science. Students may need support to transfer knowledge and skills from one discipline to another.

Ideas to try...

Liaise with your maths department so teaching is well aligned - find out how and when the skills needed in science are taught.

Teach students science-specific maths techniques and processes.

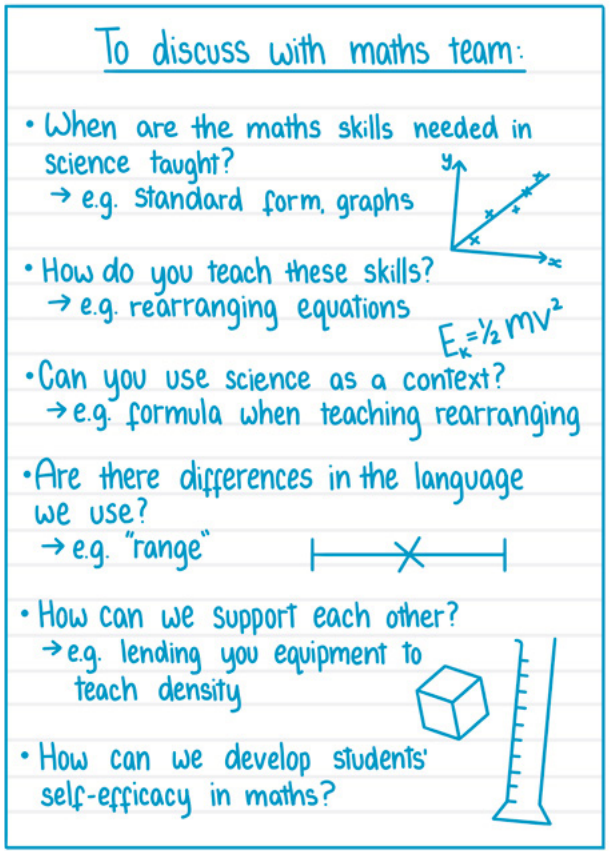
Observe a maths teacher teaching maths skills used in science.

Make effective use of worked examples and models such as bar models for proportional reasoning.

Allow plenty of opportunities to practise maths skills.

Explain key maths terms (like 'per').

Teach students how to make the best use of equation sheets.



Liaise with your maths department to support students with their maths skills.

Notes and reflection

To find more resources for inclusive teaching, scan the QR code below or visit: **iop.org/InclusiveResources**

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